The Electrical World.

VOL. XXVIII. NEW YORK, SEPTEMBER 5, 1896. No. 10.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
in the United States, Canada or Mexico; other foreign countries, $6

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXVIII. NEW YORK, SEPTEMBER 5, 1896. No. 10.

CONTENTS.

Editorial.. 269
On the Seat of the Electro-Dynamic Force in Ironclad Armatures, by Townsend Wolcott..... 271
The Load Losses Produced by Armature Currents, by Harris J. Ryan..... 272
The Cleveland Electric Illuminating Company..... 273
Combined Alternating and Continuous Current Circuit..... 275
Annual Meeting of the American Association for the Advancement of Science..... 275
The Achievements of Physical Chemistry, by W. A. Noyes..... 277
The Akron, Bedford & Cleveland Electric Railway..... 279
On the Relative Position of Engine, Dynamo and Switchboard..... 281
Failure of the Kings County Elevated Railroad..... 281
Digest of Current Electrical Literature, Compiled by Carl Hering... 282
New Books..... 286
The Nantasket Beach Electric Railway..... 286
New Dynamo and Switchboard..... 287
Eickemeyer Armature Coils..... 288
An Improved Engine..... 288
A New Railway Switch..... 289
The Straight-Line Engine and How It Is Made..... 289
DEPARTMENTS:
Financial Intelligence..... 290
Special Correspondence..... 290
General News..... 293
Personal Notes..... 294
Trade and Industrial Notes..... 294
Illustrated Record of Electrical Patents..... 295

IRONCLAD ARMATURES.

In a communication which appears elsewhere in this issue, Mr. Wolcott takes up a theoretical consideration of the question advanced by Messrs. Houston and Kennelly in an article which appeared in THE ELECTRICAL WORLD of July 4 last on the seat of the electro-dynamic force in ironclad armatures. Although we are aware of no criticism having been made concerning the experimental results which apparently demonstrated that the torque in an ironclad armature is exerted upon the teeth and not upon the conductors, Mr. Wolcott evidently believes that further corroboration, which he offers, is necessary. We are in perfect accord with the statement that no magnetic pull on a conductor is to be expected where the magnetic force is zero, as was probably the case with the exception of a slight stray field, under the experimental conditions of Messrs. Houston and Kennelly. These conditions, however, were not necessarily the same as will exist with a revolving armature, so that the question naturally arises whether the experiments have really demonstrated that under the normal conditions of operation the torque is exerted upon the iron and not upon the conductors. Although the conclusions drawn by Messrs. Houston and Kennelly are doubtless correct, there is justification for the doubts which Mr. Wolcott infers have existed. We should be pleased to learn of other methods being devised for the purpose of testing under running conditions.

THE COMMERCIAL APPLICATIONS OF OZONE.

The disinfecting properties possessed by ozone have been more or less generally known for a number of years, but owing to the limited means available for its production it has until quite recently failed to receive very extensive application. According to a recent paper by M. Répin, ozone readily destroys bacteria of the various kinds to be found in drinking water together with any organic substances which the same may contain, but leaving unchanged any medicinal properties possessed by mineral substances in solution, so that the most polluted river waters, it is claimed, may be thoroughly sterilized in a manner preferable to either boiling, which removes the air contained in the water, or by filtering, which process, although it removes impurities in suspension, fails to act upon those which have been dissolved. The production of ozone on a commercial scale has given very satisfactory results in cases where it has been attempted, and will shortly be introduced in several of the large cities in Europe. The field is one which offers an opportunity for profitable invention, and will doubtless therefore be soon occupied by American inventors. The purifying of city waters, although perhaps not required in American to such a large extent as in European cities, yet is one which deserves serious consideration in not a few localities. The production of ozone in connection with existing water-works is worthy of investigation on the part of municipal authorities.

CONVENTION VS. GOOD PRACTICE.

Since the early days of arc lighting it has been customary to place instruments and regulators on the positive side of the circuit. With arc machines this method is advisable, because otherwise a dangerous difference of potential would exist between the various instruments. This convention was adopted in railway practice, notwithstanding other methods have a distinct advantage. For instance, where the trolley wire is made the positive side of the circuit, the breakers are placed entirely upon this side, with the result that they but partially protect the generators from short circuit, since nine tenths of all circuit-breakers are of the single-pole type. Only

recently have boards been constructed with the machine breakers on the negative side and circuit-breakers on the positive. In laying out the equalizers it is necessary to so interpose equalizer switches that when one generator is shut down it is completely dead when these switches are open. This necessity results from the fact that the series field coil is on the positive side and therefore 550 volts above the ground. By placing the series coil on the negative side only a few volts difference of potential would exist between the equalizer and the ground, so that the equalizer could safely be left without further attention. This method would not only eliminate the cost of an equalizer switch, but would also avoid the serious accidents resulting from a neglect to close the switch at the proper time. In addition there are the important advantages of both shortening the equalizer cable and eliminating the resistance inherent in switch jaws. These changes, though apparently trifling, would result in a material improvement in regulation as they would tend to produce more nearly the ideal equalizer of no resistance.

THE GENEVA ELECTRICAL CONGRESS.

It is to be regretted that the electrical congress held at Geneva, Switzerland, from August 4th to the 8th, failed to accomplish the results which its originators had contemplated, and that it was not sufficiently representative in its nature to pass upon the questions brought up for discussion with any degree of authority, or with the surety that the resolutions adopted would be considered with favor by the various bodies whose representatives were supposed to constitute the principal part of its organization. This result is to be mainly attributed to the amateurish manner in which the preliminary details were arranged. Not the least prominent feature which presented itself was the almost unanimous rejection of the magnetic units provisorily adopted by the American Institute of Electrical Engineers, although advocated and proposed by so eminent an authority as Prof. Hospitalier and supported by Kowalski. Prof. Ferraris considered that the units were neither necessary, useful nor well chosen, while Mr. Kapp maintained that the present magnetic expressions, such as lines of force, ampere turns, etc., were preferable, the same argument which has been continually brought forth without regard to the merits which a practical magnetic system of units would possess. As a consequence, none were adopted. In contrast to the rejection of the proposed magnetic units was the inconsistent, but by no means unanimous, adoption of a system of photometric units based upon no reliable and determinable standard. The units provisorily agreed upon are based upon the luminous intensity of a punctiform source of light, and are defined as follows: The "bougie décimale" for the unit of luminous intensity and designated by the letter I, the same to be provisorily represented for industrial needs by the horizontal luminous intensity of the Hefner amyl-acetate lamp; flux of light by the "lumen," designated by the Greek letter $\Phi = I\sigma$, where σ is a solid angle of an infinitely small cone of light; illumination by the "lux" or lumen per square metre, and designated by $E = \Phi/S$; brightness by the bougie décimale per square metre, and designated by $\epsilon = I/S$; quantity of light by the lumen-heure, designated by $Q = \Phi \times T$. The suggestion of the Institute Committee, appointed in 1893 for the purpose of investigating the subject of a suitable standard of light, to base practical photometric units on the incandescence of a block of carbon, the temperature of which has been determined, was rejected, being considered as not sufficiently definite, inasmuch as it would be necessary to work with special carbons in a vacuum. The principal contention was against the term bougie, and it was suggested by M. Blondel that it be entirely abolished and the term "Pyr" be substituted for it. This, however, failed to meet with favor, with the result that the bougie décimale was finally adopted. Thus it will be seen that owing to the non-concurrence of the delegates present, and the fact that neither England nor America was officially represented, the final international adoption of both photometric and magnetic units remains to be settled by a future congress. It is to be hoped that ere another congress convenes some definite standard of light will have made its appearance.

LIGHT PHENOMENA POSSESSED BY RONTGEN RAYS.

During the early stages of progress in the study of the Röntgen rays it was generally admitted that they are non-homogenous in their nature. Recent experiments by Mr. McClelland have more fully confirmed these results, the experiments being based upon the rate of discharge produced by the rays when falling upon a discharged disc connected to an electrometer. Mr. McClelland first interposed between the rays and the charged disc a plate of glass and measured the rate of discharge. A sufficient number of sheets of tinfoil were then interposed, so that the previous rate was approximately obtained, the ratio of the rates of discharge in the two cases being a measure, therefore, of their relative transparencies. A second pile of tinfoil sheets were then interposed together with the glass and the rate of discharge noted, after which the glass was removed and the original tinfoil pile substituted and its rate of discharge again measured. As the ratios found for the glass and tinfoil pile and the two tinfoil piles, respectively, were different, it was concluded that some rays were more readily absorbed by the tinfoil while others by the glass. It was shown after testing various substances in this manner that the degree of selective absorption varied considerably, some substances showing none at all. It is interesting to compare these results with those of Dr. L. Fomm, who has investigated the wave lengths of Röntgen rays by the diffraction method used several months ago by Prof. Rowland. In these experiments the rays passed through a slit half a millimetre in breadth, in turn being diffracted by a second slit and finally received upon a sensitive plate. It was found that as the width of the second slit increased, the interference lines approached each other until a single dark line appeared, producing a first minimum. As the width of the slit increased, the well-known light phenomenon of a maximum, with a minimum on either side, was produced, and according to Lommel's formula the wave length was found to be .000014 millimetre, a figure about one-fifteenth that of the smallest wave length of ultra violet light hitherto recorded. Prof. Rowland, in a communication to The Electrical World, April 25, 1896, stated that the wave length was not greater than .00007 of a millimetre, about one-seventh that of yellow light. The results of M. Sagnac show that, according to his experiments, the wave length cannot be greater than .00004. The inherent difficulties in making observations in measuring the amount of diffraction, together with the non-homogeneity of Röntgen rays, accounts for the discrepancies between these several figures, but they all, however, point to the one result, that Röntgen rays are of exceedingly small wave length.

Government Telegraphy.

As regards the telegraphs, we notice that the press of America opposed to Mr. Bryan's Presidential candidature, is driven to making disparaging comments on the English telegraph system, pointing to it as an example of financial failure, and even of practical inefficiency. We can afford to smile at these comparisons, merely remarking that, if the telegraphs are so superior in private hands, there can be no reasonable grounds for their being the reverse in the hands of the Government. If we have made mistakes, the United States may profit by them as warnings; but nobody denies that the net result has been a great national boon, and one which it is a pity the United States should lose because of its being associated with doctrines and projects which are economically and socially mischievous.—*London Electrician.*

On the Seat of the Electro-Dynamic Force in Ironclad Armatures.

BY TOWNSEND WOLCOTT.

The communication by Messrs. Houston and Kennelly, which appeared in THE ELECTRICAL WORLD of July 4, on "The Seat of the Electro-Dynamic Force in Ironclad Armatures," seems to have caused some perplexity and surprise, for the following reasons: Most electricians have had the fact forcibly impressed upon them either by personal experience or by reading that the torque, or at least the greater part of it, in smooth-cored armatures is exerted upon the armature's conductors, tending to make them slide upon the core. It is further known that projecting teeth do not increase the flux through the air gap. If the teeth do not affect the torque in amount, it seems unlikely that they will take it away from the conductors and appropriate it to themselves. This conclusion, however, is not sound, as will appear on closer study. The Maxwellian school made a distinction between the magnetism of iron and that of the free space, and the quantity called by Maxwell "magnetization" does not exist outside of the iron. This position is held in scorn by certain mathematicians, who claim that the only difference between iron and free space is in the reluctance. To this view it is only necessary to present a single instance of difference. The line integral of magnetic force around a closed path is zero in all cases if the magnetic field belongs to a permanent magnet, even if the path passes through the magnet itself. If the field belongs to a coil of wire the line integral is zero unless the path interlinks with the wire, in which case it is 4π times the current strength for each interlinkage in one direction and -4π the current strength for each interlinkage in the opposite direction. This well-known theorem has no immediate connection with the matter under discussion except that it shows the real difference, and that we ought not to jump at the conclusion that the substitution of iron for an air gap in a dynamo affects only the reluctance.

To account for the experimental results obtained by Messrs. Houston and Kennelly, it is necessary to go to first principles. In the case of attraction between two electromagnets, no one questions that by far the greater part of the pull is between the respective cores. Whatever attraction there may be between the two windings, or between the winding of one magnet and the core of the other, is comparatively unimportant. It is obvious that in a machine having an armature consisting of one or more electromagnets, which alternately approach and recede from the field magnets, there will be a direct pull between iron and iron. All the very early dynamos and motors were built upon this plan, but when the smooth-core Gramme and Siemens dynamos were introduced the opposite extreme was almost reached. The only question then is whether the modern toothed core is a partial reversion to the old type. The experiment of Messrs. Houston and Kennelly answers the question in the affirmative in so far as the static torque is concerned, but there has been doubt in the minds of some whether the rotation of the armature producing the E. M. F. might not introduce a new condition which would modify the result. To actually measure the different components of the torque, while the armature is in motion, seems to be impracticable, and the best we can do under the circumstances is to see if there is any theoretical consideration whereby we can account for any part of the torque being transferred from the iron to the wire in consequence of a counter E. M. F.

There are two ways of defining what takes place when a E. M. F. is induced in a conductor. First, by the number of lines cut, and second, by the variation in the number of lines enclosed in a given time. In the majority of cases it is immaterial which idea is used, although there are exceptions to both rules. In all forms of unipolar machines the electric circuit does not enclose the lines at all, or if it does, the number enclosed is not altered by the rotation of the movable part. On the other hand, in cases where there is a complete magnetic circuit of iron, so that all, or nearly all, the induction is through the iron, there is little or no external field, and the number of lines cut is not a measure of the induced E. M. F. A case of this kind is represented in the ordinary transformer. Even in its commercial form, where there is considerable stray field, the greater part of the field is in iron, and reverses in the iron without cutting the secondary wire at all, so that the secondary E. M. F. is measured by the variation of the enclosed flux, but not by the number of lines cut. Again, when a conductor is completely surrounded by iron, as in some ironclad armatures, there is no field in the space in which the wire lies, or at least the field is very small. Now, when the armature revolves the lines disappear on one side of the wire and appear on the other, and a corresponding E. M. F. is generated. The lines are commonly said to cut the wire, and the difficulty involved in this assumption that there are no lines to be cut in the space where the conductor lies is avoided, or more properly, an attempt is made to avoid it by the dogmatic statement that the lines snap over the space one at a time. Just what is meant by this statement is not clearly defined by those who use the term. It either involves the assumption of an infinite velocity of the lines in the space or else the presence of a finite flux therein, neither of which assumptions is justifiable. If the lines pass through the space in the same sense that they pass through the air gap of a smooth core machine, we would expect the torque to be exerted on the conductor in the same way as the smooth core machine. But the lines do not exist in the space, and there is no reason for expecting the torque to be exerted on the conductor. That is to say, there is no reason to expect a magnetic pull on a conductor carrying an electric current in the region of the space where the magnetic force is zero. Of course, when a current is flowing in a conductor it alters the distribution of the magnetism in the iron, but not in a way to invalidate the foregoing statements.

If two mutually attracting electromagnets are allowed to approach there is a counter E. M. F. set up in the windings of each, but that does not alter the fact that the greater part of the pull is on the cores. In a deep toothed armature core the teeth are virtually separate magnets. If the magnetization of the iron in the Maxwellian sense be considered, the induction in a region where the resultant force is zero may be accounted for without considering any snapping of magnetic lines. This method was pursued by the writer in a paper read before the New York Electrical Society and published in THE ELECTRICAL WORLD, Dec. 4, 1886.

Metallic Carbide.

Among the many new fields of work opened up by the introduction of the electric furnace, according to *Nature*, was the preparation of difficultly reducible metals undertaken with success by M. Moissan. These reductions being necessarily effected by the presence of carbon, the formation of definite metallic carbide of great stability soon became apparent, the properties of which came to be of such interest that their preparation was systematically attempted. Certain metals, such as gold, bismuth, lead and tin, did not form carbides at the temperature of the electric furnace, neither do they dissolve any carbon. The metals of the platinum group dissolve carbon with facility and deposit the whole of it, on cooling, in the form of graphite, the metals being unchanged. Copper, silver and iron take up carbon in quantities, which, although small, are sufficient to cause marked changes in the physical properties of the metals; it is noteworthy that no definite crystalline compound could be obtained with iron. On the other hand, fused aluminum takes up carbon readily in the formation of the crystalline carbide, AL_4C_3, and the oxides of many other metals furnish similar crystalline compounds when heated in an electric furnace with an excess of carbon. The behavior of these substances with water furnishes the most convenient mode of classification. The carbides of molybdenum, tungsten, titanium, zirconium, the latter having two, and of chromium, also having two, do not decompose water at the ordinary temperature. Of these reacting with water, the carbides of lithian, calcium, strontium and barium furnish a pure acetylene; of aluminum and of beryllium, pure methane; of manganese a mixture of equal volumes of hydrogen and lethane; while metals of the cerite group give crystalline carbides, all of which react with cold water, forming a complicated gaseous mixture containing hydrogen, acetylene, ethylene and methane. But the most complex reaction is that furnished by uranium carbide with water. In this case in addition to the gaseous mixture containing methane, ethylene and hydrogen, liquid and solid hydro-carbons are produced in abundance. The carbides of silicon and titanium are extremely hard, the latter even cutting diamond.

Primary Batteries for Lighting.

It is stated by an English writer, who seems to have had some experience, that when accumulators are charged slowly with primary batteries for small installations, the useful voltage obtained from the accumulators on discharging is higher than that which could be obtained from the batteries directly, owing to the rapid fall in the voltage of the primary batteries if they are used directly. The regulation is also far better.

The Load Losses Produced by Armature Currents.

BY HARRIS J. RYAN.

I have known of the load losses produced by armature currents, discussed recently by Mr. Bláthy, since September, 1894. These losses are due to armature reaction, which causes increase in the hysteresis and eddy currents in the armature core, conductors and, to a small extent, in the pole tips.

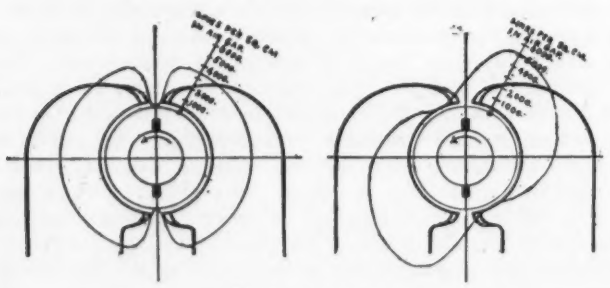
Dr. C. E. Emery and I came across these phenomena at the close of our labors in working out the results of a series of tests of the large World's Fair engine dynamos, undertaken by a special committee of the Board of Awards in the department of electricity, with Dr. Charles E. Emery, of New York City, as chairman. The input-output efficiency curves of the dynamos, with their efficiency curves as estimated by obtaining the ratios of the outputs to the sums of the outputs, and the internal losses, determined by measurements direct of the field excitation, the hot armature resistance and the power required to drive the armature core through the field, working on open circuit at regular speed and producing the full total E. M. F. of full load, were compared by Dr. Emery. For the input-output efficiencies, the inputs were obtained from the indicator cards and the outputs were read from approved direct current ammeters, voltmeters and wattmeters which had been thoroughly checked for reliability and for absolute adjustment. The indicators were carefully calibrated by the most approved methods. The final result was that the two classes of curves, as above, differed by about 3 per cent. for the full load efficiencies. The estimated efficiencies were higher by this difference than the input-output efficiencies. The difference ultimately could only be accounted for in the following manner, as described in my letter to Dr. Emery under date of Sept. 18, 1894:

"I have looked over the copy of your splendid report and I am now sending it to Prof. Carhart, together with a copy of your letter.

"I have indeed no changes whatever to suggest in any part of the report, as it pleases me exceedingly much.

"Referring to what you say in your letter about the increase of the armature drag, it seemed proportional to the exciting forces, etc. It seems to me now that you are correct. In all machines the induction densities vary more or less, as in Figs. 1 and 2. The crowding of the induction to one side of the pole also bunches it somewhat in the core of the armature. The hysteresis and eddy losses, since they vary as the 1.6 and 2.0 powers of the induction density, will be the greater the more we bunch the induction in a given armature and in the pole-pieces too, where they are not laminated.

"The exciting force varies frequently with these distortion effects, but here much depends upon the design of the particular machine. For example, in Fig. 2 we have a case where there was the greatest ordinary amount of field distortion or bunching of the armature induction, yet the exciting forces did not change with the load for



Figs. 1 and 2.

constant potential. Generally the T-toothed armature for constant pressure requires increased exciting force in proportion to the load, but here again it may be changed by the character of the load (in alternate-current working), that is whether the load is non-inductive or inductive, and the bunching of the magnetism would be influenced by either.

I have a machine that has a pole-face winding, arranged for doing away entirely with the armature reaction. This winding is put on as shown in Fig. 3, and you remember I told you about it when you were up to see us. This winding can be used for bunching the induction, just the same as is done by the current in the armature under load.

"By running the machine light as a motor the power required to rotate the armature at a given speed and pressure or total induction, with the induction uniform or bunched, is at once determined from the readings of the electrical instruments. I did this on the 15th inst. (Sept. 5, 1894). The pole-pieces are solid cast iron, and the armature iron clad. I found that the power that kept the armature at speed as 100 volts with uniform induction was 200 watts, and with bunched induction, 220 watts, total armature induction and speed remaining the same for both cases. In order to show how much the armature drag may be changed by the armature reaction, one should have a machine rigged with such a pole face winding, fitted with the laminated poles so that high densities might be obtained. In my experiments on Saturday the highest density used when the induction was most bunched was not more than 5000 lines per sq. cm (10,000 C. G. S. in the armature teeth)

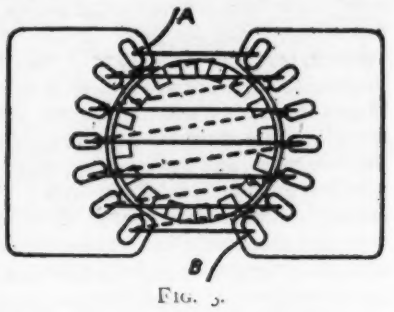


Fig. 3.

"I now believe that you are right in thinking that the armature drag may vary as much as the exciting force in the —— alternator."

The above letter was to have been published along with the complete report of the committee in the Government report of the work of the Department of Awards as planned by the Exposition authorities, but which for some reason was not finally accomplished.

As an introduction to a paper read before the American Institute of Electrical Engineers, March 20, 1895, I said in connection with Fig. 4: "The pernicious cross-leakage effects that occur with the use of deep grooves and saturated lugs under the trailing-pole corner are quite obviated (when armature reaction is prevented), so that woven or sectioned conductors are not necessary." Our makers for some time have been familiar with the additional heating in the armature conductors that comes from the bunching and twisting of the magnetism due to armature reaction.

The General Electric Company, when constructing the motors for the North Side Chicago Elevated Road, adopted for armature conductors in each narrow groove two ribbons laid edgewise over one another. The under ribbon was made of copper wires designed to break up eddies due to cross-magnetization, while the upper conductor was made of a plain copper ribbon with two slots running throughout the length of the armature core. The heating due to the twisting of the field, which was worse for the under than the upper conductors, was thus virtually overcome. I know from con-

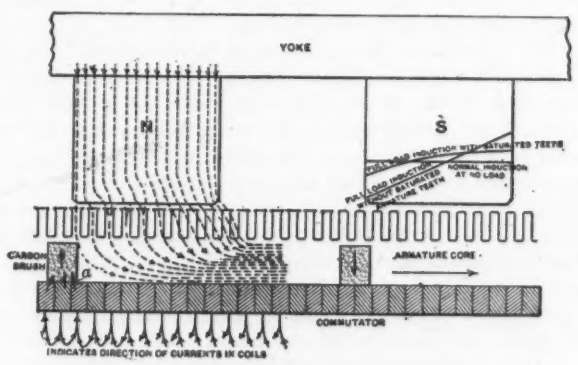


Fig. 4.

versation with our American designers of electrical machinery, that they have generally been acquainted with Mr. Bláthy's load losses produced by armature currents for several years.

Educating the Masses in Electricity.

The following lucid description of a "Secondary Storage Battery," is given by an Eastern paper of some repute: "A new secondary storage battery has been patented for locomotive purposes, in which the liquid forming the electrolyte while having free access to the plates, is contained in a suitable absorbent to prevent the free movement of such electrolyte. This corresponds in second batteries to what is known as the dry battery in primary cells."

The Cleveland Electric Illuminating Company.

CLEVELAND is a city which has attained within the last few years a leading position in electrical development, and one in which is embodied the latest and most approved systems, apparatus and methods of operation in applied electrics. It is the purpose of this brief sketch to present in a necessarily outline manner the chief features to be found in the plant of the Cleveland Electric Illuminating Company.

The company has completed a new power-house, which has been in operation for some time. Descriptions from the plans and specifications have been published, but the actual power house in its completeness has been radically improved in many points of technical interest.

The building was designed with the object of consolidating two power-houses, that of the old Brush Electric Light & Power Company and that of the Cleveland Electric Company, thus forming a most complete power-house of greater capacity and of the most improved and efficient type.

The Brush Electric Light & Power Company, using the Brush system, controlled the municipal arc-lighting of the city, while the T.-H. plant under the control of the Cleveland Electric Light Company, furnished arc, alternating, and low tension incandescent lighting by the Thomson-Houston system.

The site of the new plant was selected on account of the facilities for securing coal. its close proximity to the Cuyahoga River for condensing purposes and its central electrical location. Owing to the great difficulty of properly preparing the foundations, it was necessary to pile the entire property to a depth of 30 feet to avoid quicksands and springs. The station was designed for high tension series alternating-current arc lights, low tension incandescent light and power. The building is located on Canal Street and extends back to the Valley Railway. There are three floors. The first is devoted to

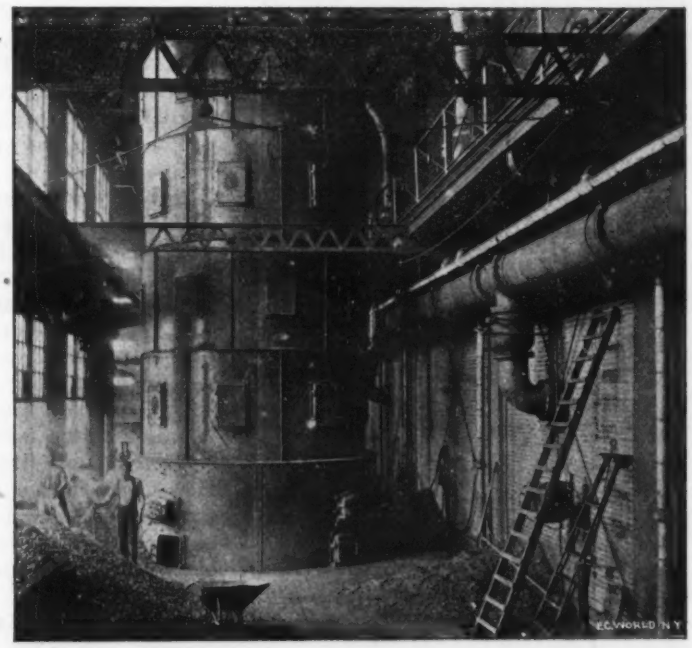


FIG. 1.—BOILER ROOM.

the engines, boilers and jack shafting; the second to the dynamo machines, and the third serves for storage purposes. The main portion of the building is swept by two Yale & Towne cranes of about 28 feet span, one with geared trolleys and hoists, having a total capacity of 10 tons. The other crane has a capacity of six tons and a single geared trolley and hoist.

The building has a basement under both engine and boiler rooms. A layer of concrete two feet thick forms the foundation of the line walls of the building and the machinery foundations. The building is composite in its structure, the frame being of iron, as are also the roof girders, while the in-walls are of brick, with Berea sandstone trimmings. The large hall is lighted by skylights fitted with one quarter inch ribbed glass. The boiler room is ventilated by steel ventilators with fixed steel slats and doors to gain access to the

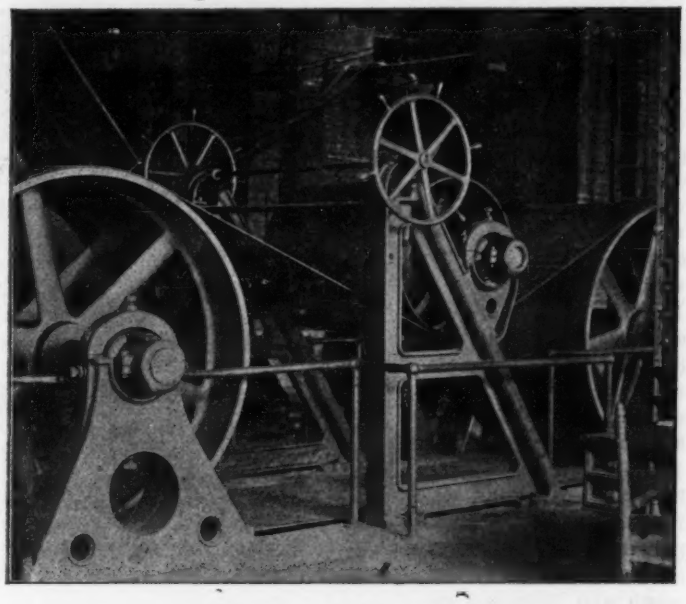


FIG. 2.—BELT TIGHTENER.

breeching or smoke-flue. The latter extends directly over the boilers to a steel stack at the end of the building, which is 227 feet high and is the highest steel stack in this country. The stack has a 25 foot 6 inch cast iron base and is built of steel plates seven sixteenths of an inch thick at the base and diminishes in thickness until the top plates are reached, which are one quarter of an inch thick. The

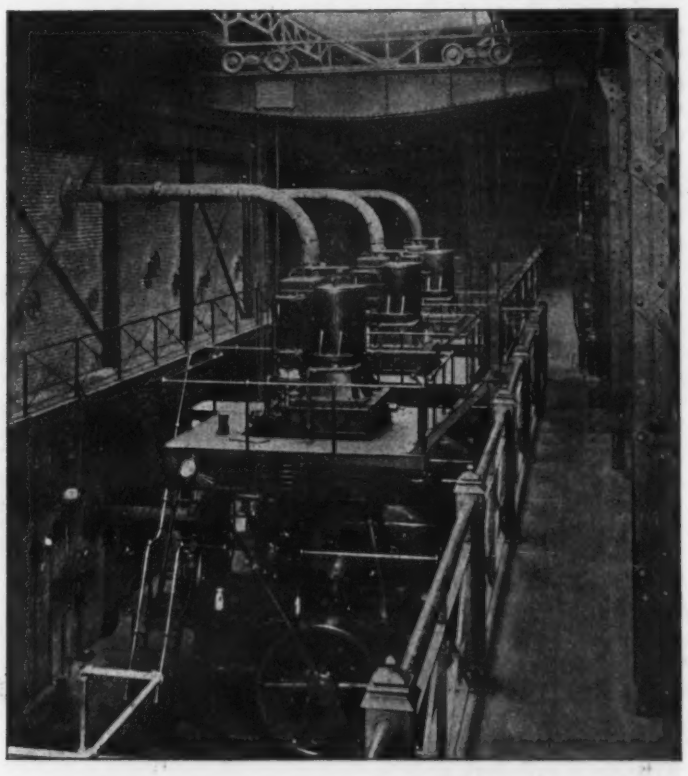


FIG. 3.—TANDEM COMPOUND-BELTED ENGINES.

steel portion of the stack base is riveted to a heavy cast iron ring which forms the base of the stack proper and which in turn is bolted to its foundation. The stack has sufficient capacity to take care of any increase of plant which can be located on the property. The foundation of the stack proper consists of brick masonry to a depth of 12 feet laid in hydraulic cement, the masonry measuring about 35

feet square, being bonded into the engine and building foundations. The brick lining of the steel shell is tapering, starting 21 inches thick at the bottom and tapering to 4½ inches thick at the top. It is of red fire brick, the inside surface being West Virginia fire brick. The stack was built and erected by Righter & Conway, of Pittsburg.

The boilers are four in number and are of the Climax vertical type. They are fired from all sides in a simple spread fire with a soft coal. Three of the boilers are rated at 800 horse-power each and one at 500 horse-power. They are built for a working pressure of 200 pounds to the square inch but the pressure used is only from 125 to 140 pounds. The boilers are fed with river water which passes through a Jewell filter and so efficiently does it perform its work that no trouble with scale is experienced. Space has been left in the boiler room for two additional 800-hp boilers. Coal is dropped from the bottom of hopper cars on the siding into the pocket underneath and delivered inside of the wall of the boiler room. It was intended to have coal-handling apparatus manage the stowing of the coal in the bunkers but it was found more convenient to dump the coal directly into the boiler room.

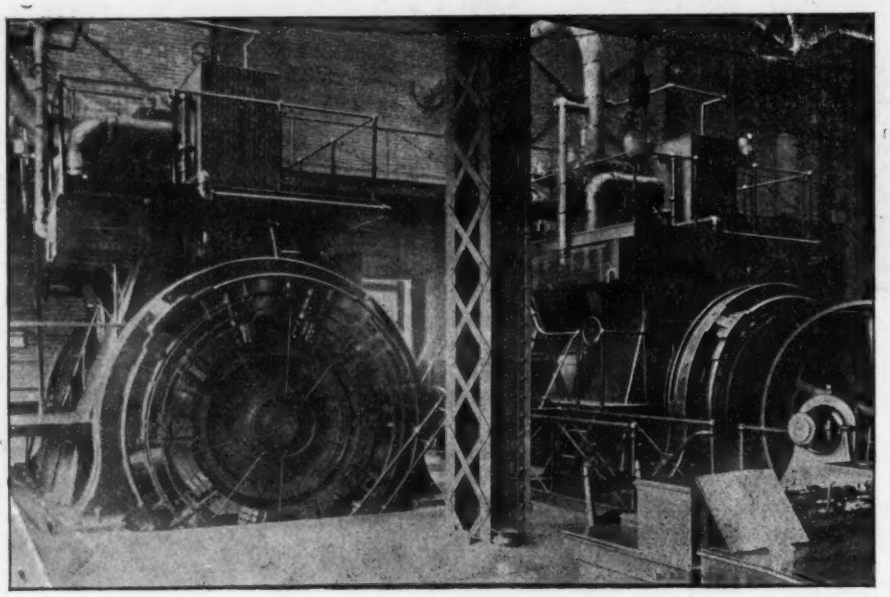


Fig. 4.—Direct-Connected Units.

Fig. 1 gives an idea of the boiler-room and the arrangement of the boilers therein. The boilers deliver their steam, without intervening separators, direct to the engines through a steam pipe system arranged to be as direct and simple and have as little drip as possible, and at the same time take care of all expansive strain. A 14-inch wrought-iron main is reduced at the ends and extends the entire length of the boiler-room, resting on specially designed girders and expansion rollers. This main is tapped through the partition wall of the boiler-room to the engines, and is fed by branches to the boilers, the whole system being suitably cut up by valves, so that practically any boiler can be thrown on any engine and the main separated in lengths. Renewals of gaskets can be made in the main without shutting down more than one engine at a time. The valves of the plant are of the Chapman gate type. These engines are all of the McIntosh & Seymour compound vertical type. Three of them have their cylinders arranged tandem and are belted to two long rows of jack-shafts, which, in turn, are belted to the alternating and arc generators. These engines have cylinders 19 and 36 inches respectively, and a stroke of 24 inches. They are capable of developing 750 horse-power each, when running condensing at 150 revolutions and with 125 pounds initial pressure. There are two other vertical cross-compound engines, each direct-connected to two 200-kw General Electric multipolar generators. These engines, which have cylinder dimensions of 20, 36 and 24 inches respectively, are capable of developing 800 horse-power, when running condensing at 150 revolutions and 125 pounds of steam.

They are of the latest type, have piston valves on the high-pressure and grid-iron valves on the low-pressure cylinders, and are governed by shaft governors. All bearings and slides are water-jacketed. A view of the three tandem engines may be seen in Fig. 3, while Fig. 4 shows the cross-compound engines and the generators which they operate. The direct-current lighting system is supplied by these direct-coupled generators at a pressure of 125 volts, and also by a couple of bipolar No. 60, 160-kw generators which are coupled by means of the jack shafts to the three tandem engines. These bipolar generators help the plant over the peak of the load and also take care of light margins so that it is never necessary to run the large machines unless they are fully loaded. The large machines, as will be seen from the cut, are of the smooth bed ring type and without a separate commutator, the side faces of the conductors being turned up for that purpose. This machine is quite well known among lighting engineers and needs but little description.

The jack shaft system, which was put in entirely by the Hill Clutch Company, consists of two long lines of parallel shafting. They may be run independently or may be coupled together by a short belt. This belt, which is very broad, has a remarkably short distance between centres and has to be provided with a belt tightener in order that sufficient area of contact may be obtained. This transmission, which is a neat piece of engineering, is shown in Fig. 2. The shaft is cut up in sections in order to render the plant as flexible as possible.

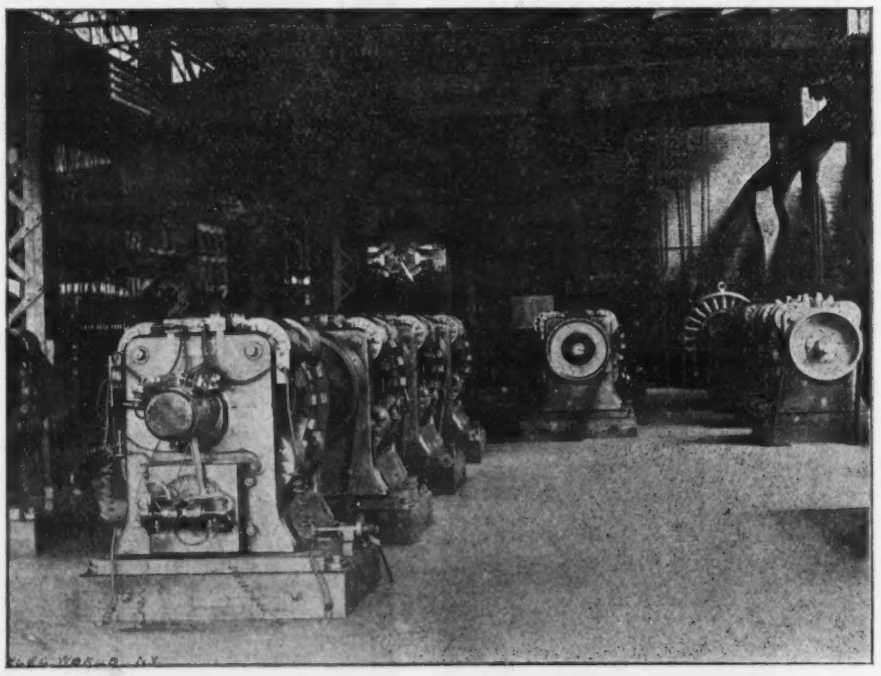


Fig. 5. Arc Dynamos.

The large direct-current units have already been described, but the belted units on the second floor are worthy of a more detailed description. A general view of them may be seen in Fig. 5. In this part of the station are located direct-current arc lighting units, direct-current incandescent units, and alternating incandescent units. There are three alternators, two of 70 kilowatts and one of 240 kilowatts. They are of the General Electric make, and deliver current at a pressure of 1040 volts. The direct-current machines have already been mentioned. The chief interest attaches to the arc lighting system.

The arc system consists of fourteen 125-light Brush arc-dynamos. They have a capacity of 9.6 amperes and a pressure of 6250 volts, and run at 185 revolutions per minute. From the illustration it will be seen that the machines are among the first of this type that the Brush

Electric Company produced. They have rectangular chair back irons and a much more liberal magnetic circuit than in the improved arc machine. The bearings are not quite as easily gotten at, but it must be remembered that these very machines, by their excellent performance, have helped to build up the reputation of the Brush arc machine, and gave the industry a fresh impetus. Each machine is provided with a new regulator, which adjusts the brushes and shunts the field coils automatically, and on the machine in the foreground of the illustration the mechanism of this regulator shows quite plainly.

Combined Alternating and Continuous Current Circuit.

In a communication which appeared in THE ELECTRICAL WORLD Dec. 21, 1895, Mr. B. O. Ellis called attention to the fact that a successful experiment had been made in operating a direct-current and alternating-current machine on a three-wire system after the plan shown in the accompanying diagram. Mr. Alexander Russell, in a communication to the London *Electrician*, makes some observations relative to this method, of which the following is an abstract:

The effects that follow the superposition of a direct on an alternating current and *vice versa* are very curious and deserve more attention than they have hitherto received. The theory is simple, a clear idea of what the effective value of an alternating current is and an elementary knowledge of algebra being all that is required. These effects have been already utilized for various practical purposes, and there is plenty of scope for further applications. In the Lowrie-Hall meter, for example, a small accumulator in series with a copper voltameter was put in the house circuit, and the gain in weight of a copper plate in the voltameter was proportional to the current used, and so could be used as a basis for charging for the current consumed. A similar arrangement has been used to measure the resistance of an alternating-current circuit when the current is flowing, and there are several other practical applications. There are also numerous laboratory experiments with combined alternating and direct pressures, which are, however, more curious and interesting than practical.

The most important practical property of combined alternating and direct currents flowing in one conductor is that each produces its own heating effect practically independently of the other. To prove it is necessary we have to find the effective value of the combined current, the determination of which the author bases upon the following well-known method: Let I be the value of the direct current, and i the instantaneous value of the alternating current. Then the value of the current at any instant is $I + i$, and the square of the effective value is the mean value of $(I + i)$—*i. e.*, of $I^2 + 2\,I\,i + i^2$. But the mean value of $I^2 + 2\,I\,i + i^2$ is $I^2 + I_1^2$ where I_1^2 is the effective value of i^2. For the mean value of I^2 is I^2, since I is constant, and the mean value of $2\,I\,i$ for a complete period is zero; for to every positive value of i there is a corresponding negative one, and the mean of the positive values equals the mean of the negative values, since as much alternating current flows in one direction as the other. Also the mean value of i^2 is by definition the square of the effective value of the alternating current. It is to be noticed that in the above proof no assumption is made as to the nature of the wave-form of the current.

If the resistance of the circuit be R, then the rate at which heat is being developed in the circuit is the average value of $R\,(I + i)^2$, which by the above equals $R\,I^2 + R\,I_1^2$. Hence each current produces its own heating effect just as if the other were absent.

The following numerical example illustrates how this theorem works out for different values. It is easy to show by arithmetic that

$$\begin{aligned} 28^2 + 29^2 &= 20^2 + 35^2 \\ &= 16^2 + 37^2 \\ &= 5^2 + 40^2 \\ &= (40.3\ldots)^2. \end{aligned}$$

It therefore follows that a direct current of 28 amperes, combined with an alternating current of 29 amperes, would produce the same heating effect as a direct or an alternating current of 40.3 amperes. The other numbers show different combinations that would produce the same effect.

This result is an important one, as it points to a possible economy in the mains when a combined alternating and continuous current plant is in use.

In the figure, C is a Brush arc machine and A is an alternator. It would have been more expensive if, instead of using a common return conductor $B\,D$, two parallel conductors had been used and the two systems of supply kept quite distinct. To make this clearer, suppose that we are allowed a current density of 1000 amperes per square inch, and that we have a cable carrying a current of 1000 amperes continuous and another carrying a current of 1000 amperes alternating alongside it, the cross-section of each cable would need to be one square inch. If they could be replaced by one cable without danger to either system of supply, then the cross-section of this cable need only be 1.4 square inches, and the power lost by heating the copper would only be five sevenths of what it was previously. The drop in volts also would in each case be five sevenths of what it was before. In the above calculation we have neglected the leakage

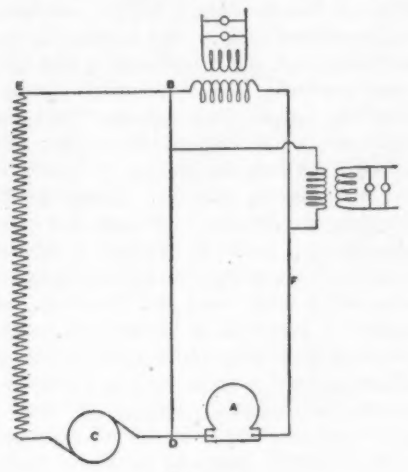


FIG. 1.

of alternating current round the branch $B\,E\,D$ and the leakage of direct round $B\,F\,D$. As in general the resistance of $B\,D$ will be much smaller than the resistance of these by-paths, the gain from this cause is not of any great value.

It might at first sight be thought that this superposing of direct and alternating pressures would seriously raise the pressure in two circuits; but this is not the case. For an alternating E. M F. of even 100 volts superposed on 1000 volts direct would give only an effective pressure of 1005 volts, and so would 100 volts direct on 1000 volts alternating. A more serious consideration is the effect of these small superposed currents on the working of the two systems. The effect of the very small alternating current in the continuous-current circuit need not be injurious to the working of the arc lamps or the dynamo. In some forms of arc lamps it might even be beneficial. Prof. Ewing has shown that an alternating current produces less and less effect on a transformer as a superposed direct current is increased; there would be thus a very slight loss due to this effect. To make up for this the loss due to hysteresis is less, and the more direct current that flows round this circuit the less will the load on the main $B\,D$ be. Again, if V equals the drop in the direct volts between B and D, and V_1 is the drop in the alternating volts, then we have the following expressions for the power expended in that part of the system:

$$\sqrt{I^2 + I_1^2} \quad \sqrt{V^2 + V_1^2} = I\,V + I_1\,V_1 = R\,I^2 + R\,I_1^2$$

The author states that it has been shown that the effective values of two combined alternating currents differing in phase by 90 degrees is the same as if one of the alternating currents was replaced by a continuous current of equal effective value. Suppose we have three currents going along a conductor, one direct and the others alternating and differing in phase by 90 degrees, then the three currents are quite independent of one another; and if we increase any one of them, the consequent increase in the heating is due merely to the increase of that one current alone. If the three currents had a value of 100 amperes each the effective value of the combined current would only be 173.2 amperes. Hence combining direct with polyphase systems may lead to possible economies. It would be advisable, however, to try a few practical experiments beforehand to see what the effect of a very small alternating-current superposed on the direct would be on the arc lamps that are to be used.

ANNUAL MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

The Buffalo meeting of the American Association for the Advancement of Science, held Aug. 24-28, was among the smallest of all recent meetings in its attendance, but the number and quality of papers presented were creditable. The surroundings were delightful, the weather being cool and comfortable, and the hospitality of Buffalonians very marked. The number of papers on electrical topics was unusually large. The vice-president for the section, C. L. Mees, led the way by his annual address on "Electrolysis and Some Outstanding Problems in Molecular Dynamics," a subject which he treated in a masterly manner. Papers were read by B. E. Moore on polarization and internal resistance of a galvanic cell, and on visible electric waves; W. S. Franklin, on the counter E. M. F. of the electric arc, and on some points in the mechanical conception of the electromagnetic field; and Mr. Franklin, associated with L. B. Spinney, read a paper on a theory of galvanic polarization; W. A. Rogers read on a photographic study of the Röntgen rays; Benjamin F. Thomas read a note on the duration of the X-ray discharge in Crookes tubes; Ernest Merritt on the distribution of high-frequency alternating currents throughout the cross-sections of a wire; Harry T. Eddy on graphical treatment of alternating currents in branching circuits; Brown Ayres on mechanical models of the electric circuit; Alexander Macfarlane on a rule for the dynamo and motor; A. D. Cole on electrical waves in long parallel wires; Edward L. Nichols and John Anson Clark on the influence of a static charge of electricity on the surface tension of water; Edward B. Rosa on a new alternating-current curve-tracer, and H. J. Hotchkiss on description and exhibition of a portable apparatus for recording curves of alternating currents and E. M. F. Synopses of these papers will follow, so far as practicable to secure them. In the section of mathematics and astronomy L. A. Bauer read on the distribution and secular variation of terrestrial magnetism. No. IV: On the component fields of the earth's magnetism.

A resolution favoring further legislation for the establishment of the metric system in the United States was adopted.

Measures were introduced and are now pending looking toward an increase in membership dues, together with a great decrease in the publication of matter in the proceedings of the association, and the subsidizing of the journal *Science*, making it the official organ of the association, notwithstanding that the association does not control this periodical; measures very repugnant to many if not most of the members.

Wolcott Gibbs was elected president. A motion by T. C. Mendenhall, as chairman of a committee, that the meeting next year should be only a formal one at Toronto, Aug. 17, after which we should adjourn to assist in welcoming the British Association, passed the nominating committee against fierce opposition by those who regarded the move as the death-knell of the association, but was fortunately reversed in general session after a thorough discussion led by the writer; and instead, it was ordered that a regular meeting be held next year at time and place to be appointed by the council. Many invitations have been received, the most urgent being from Seattle and San Francisco, accompanied by extraordinary reductions in rail fare. Prof. Harrington, formerly chief of the Weather Bureau, now president of the University of the State of Washington, brings cordial invitations from Seattle; and it is known that members of the British Association will go to Vancouver, many of them immediately after the adjournment of their meeting at Toronto; hence it is believed that a considerable delegation would attend a meeting if held at Seattle.

At a subsequent meeting of the council, held the same afternoon, the council respected the decision of the general session and arranged to hold a regular meeting in 1897, notwithstanding that T. C. Mendenhall still insisted on his original proposition and urged the council to ignore the vote of the general sessions. The time of the meeting was appointed for Aug. 9, 1897, and the place selected was Detroit, providing for a removal to Toronto, before the final adjournment, so that the American Association for the Advancement of Science might be in session at Toronto and welcome the British Association on its arrival here on Aug. 18.

The change of policy in the relation of the association toward the affiliated societies, which was begun this year by the Geological Society, and was favorably mentioned by THE ELECTRICAL WORLD in an editorial of Aug. 22, was extended to the Chemical Society, which is invited to unite with the chemical section of the association, and occupy the first two days of the meeting.

The chemists turned out in force, with many papers, before their own society, and about 70 papers before the chemical section also; a larger number than before any other. None of them were of electrical interest, however.

The papers read before the section of social and economic science aroused the most general interest in the community, notwithstanding a disposition on the part of some members of other sections to sneer at this section and disparage it. The fact that the first paper read to this section was one of only two printed in full by the daily newspapers, out of nearly 300 in all read in the various sections, may be regarded as proof of this statement. The subject of the paper was "The Monetary Standard."

A very notable occasion was the exercises on Wednesday complimentary to Prof. James Hall in recognition of his 60 years of labor in scientific fields in this State. Prof. Hall was present, looking still hale and hearty.

Reference was made among other things to the notable gathering of this very association at Albany 40 years ago to dedicate Dudley Observatory, at which Prof. Hall presided, an occasion which brought together the largest and most brilliant gathering of scientists held in America before the war. Prof. Joseph La Conte who attended this meeting was present at Albany then. The writer was also present at that time.

The general lectures to the association were by I. W. Spencer on "Niagara as a Time-Piece" and by E. D. Cope on "The Results of Cave Explorations in the United States and Their Bearing on the Antiquity of Man."

After the close of the meetings a very pleasant excursion was made to Niagara on Saturday as previously arranged.

DESCRIPTION OF AN ENGINE INDICATOR, BY THOS. GRAY.

Instrument designed to give a continuous series of indicator cards, showing the performance of the engine under any variable conditions; as, for instance, the speeding up of a locomotive from rest to full speed. The cards are written on a continuous paper ribbon, which is fed forward by a pulsating movement in synchronism with the motion of the piston, while the indicator pencil records steam pressure.

ON THE YIELD POINT OF STEEL, BY THOMAS GRAY.

This was an exhibition and description of a series of autographic diagrams showing the behavior of the steel as the tension or compression is increased from zero up to the breaking point of the specimen. The diagrams were obtained by means of the Rhiele-Gray recording apparatus.

They illustrated the effect of different intervals of rest between the successive extensions beyond the yield point on the force required to produce permanent set. Also the effect of rate of loading on the form of the diagram at the yield point.

MECHANICAL MODELS OF THE ELECTRIC CIRCUIT, BY BROWN AYRES.

The energy equation for the electric circuit

$$eidt = i^2 v\,dt + Li\frac{\delta i}{\delta t}dt + \frac{idt\int idt}{c} + \text{etc.},$$

has analogies in the dynamical equations

$$Fv\,dt = v^2 r\,dt + Mv\frac{\delta\omega}{\delta t}dt + \frac{v\,dt\int v\,dt}{\varepsilon_1} + \text{etc.},$$

and $$Tw\,dt = \omega^2 r\,dt + I\omega\frac{\delta\omega}{\delta t}dt + \frac{\omega\,\delta t\int \omega dt}{\varepsilon_2} + \text{etc.}$$

in which F is force, v velocity, r frictional resistance, M mass, and E a coefficient of the nature of Young's modulus (or its reciprocal), T is torque, ω angular velocity, I moment of inertia, E_2 a coefficient of the nature of rigidity (or its reciprocal). A mechanical model of the circuit may be constructed to realize either of the dynamical equations. Such models have been proposed by Maxwell, Rayleigh, Lodge and others. The model exhibited and operated by the author of this paper operates according to the second equation. It is composed of heavy fly-wheels free to rotate on fixed shafts (in the form of a rectangle) and connected to each other and to the driving wheel by spiral springs. It represents perfectly the phenomena of making and breaking an electric circuit, and the phenomena of alternating currents, electric resonance, etc. Its value lies in the clearness with which the ideas of the electric circuit may be grasped by its means. Its novelty is in the details of its design and in the fact of its being the first model to represent the complete circuit in an operative form.

ON THE DISTRIBUTION AND THE SECULAR VARIATION OF TERRESTRIAL MAGNETISM. NO. IV: ON THE COMPONENT FIELDS OF THE EARTH'S PERMANENT MAGNETISM. BY L. A. BAUER.

In this paper that part of the earth's permanent magnetism which is symmetrical about the earth's rotation axis is separated from that which is unsymmetrical. The unsymmetrical part is resolved into two fields, one of which can be referred to a homogeneous magnetization about a diameter lying in the equatorial plane and the other, a complex one, called the residual field. The magnetic field resulting from the combination of the symmetrical field with the homogeneous equatorial field will represent at least 70 per cent. of the earth's total field. This combined or resultant field, termed in brief the homogeneous magnetization field, has been adopted as the so called normal magnetic field. Whatever is left of the earth's total field after deducting this normal field constitutes the residual field referred to above. Some interesting and important deductions were made. Thus, for example, it was shown that the residual field has characteristics precisely analogous to those of the diurnal variation field. It differs thus radically from the homogeneous field.

ABSTRACT OF PAPER ON THE INFLUENCE OF A STATIC CHARGE OF ELECTRICITY UPON THE SURFACE TENSION OF WATER, BY E. L. NICHOLS AND J. S. CLARK.

In this paper are described experiments upon the size of the drop delivered by a water dropper at different electric potentials. The phenomenon which was looked for was a diminution of the size of the drop with increase of potential. The effect of an electric charge upon a water jet is well known, and the phenomenon is one which is most readily explained by a diminution in the surface tension of the liquid. So far as known to the writers, however, no quantitative measurements touching this point have been made.

It is the object in this investigation to obtain direct evidence of the electric charge upon the surface tension. The method consists in weighing the water collected from a glass dropper when the liquid is at zero potential, and when it is maintained at various high potentials by means of the action of a Holtz machine, driven at constant speed by an electric motor.

Potentials were measured by means of a modification of the repeated ball electrometer. After many trials a form of water dropper was obtained, by means of which the average deviation in determinations of the drop taken by weighing groups of 20 drops varied from the mean of 16 such weighings by less than 1001. By means of weighings of the drop, when the dropper was charged to voltages varying between zero and 11,000 volts, the data were obtained from which the tension could be computed as a function of the potential.

Temperatures were carefully measured by means of a thermo-element, and all weighings were reduced to a standard temperature. The results obtained show that the surface tension diminishes slowly at first with increase of potential, then more rapidly until at 11,000 volts it is reduced to zero. WM. H. HALE.

The Achievements of Physical Chemistry.*

BY W. A. NOYES.

"Physical chemistry is the chemistry of the future." These words, quoted from an address by Prof. Du Bois-Reymond, were used by Ostwald[1] 10 years ago in the introduction to the first number of the *Zeitschrift für Physikalische Chemie*. In using these words Du Bois-Reymond looked forward to a time when it shall be possible to give a mathematical expression to all forms of chemical knowledge. The picture in his mind seems to have been that of a sort of astronomy to the atoms, in which the motions and forces within the molecules shall be known very much as are the motions and forces within the planetary system.

So far as any practical realization is concerned, the thought is still only a poetic fancy and whatever progress, if any, may have been made, comes to us from organic rather than from physical chemistry.

In 1884 Arrhenius published the results of researches in the electrical conductivity of solutions, on which he had been engaged for two years. In the course of his studies he was led to the conclusion that only a part of the molecules of an electrolyte are concerned in conveying the electrical current, and that it is necessary to distinguish between "active" and "inactive" molecules in this regard. The conductivity is greater, in proportion to the amount of the electrolyte present, for dilute than for concentrated solutions, and for an infinite solution the molecules would, presumably, become all "active." Arrhenius pointed out also that there is a close connection between the number of "active" molecules, as determined by the electrical conductivity of solutions, and the "avidity" of acids as determined by the thermo-chemical researches of Thomsen. His first explanation of the cause of the difference between the "active" and "inactive" molecules was, however, unsatisfactory and was not well received.

Shortly after, in his first development of his theory of solutions, van't Hoff was compelled to admit that many substances in aqueous solutions cause a depression of the freezing point much greater than they should in proportion to their molecular weights. He expressed the deviation by the use of a factor "*i*," which is, for electrolytes, always greater than unity and expresses the number of times the depression exceeds the theoretical depression as calculated from the molecular weight. This factor was at first considered to be a constant, but it is now known that it is a variable and that it increases with the dilution. The obvious meaning of this factor is that the molecules of electrolytes are separated into two or more parts when dissolved in water or other liquids which have a similar effect in causing electrical conductivity. But, just as chemists were very slow to see, that the abnormal densities of ammonium chloride and of many other substances are due to dissociation, so van't Hoff did not draw a conclusion which seemed to be so contradictory to all preconceived notions about the bodies in question. Arrhenius, however, saw the logical conclusion, and his studies had prepared him for its acceptance. As a result he proposed, in 1887, his theory of electrolytic dissociation.[2]

This theory, which seemed at first very improbable, has shown itself capable of co-ordinating the facts of many diverse fields of work, and has proved more valuable in the incentive which it has given to research and more prolific of results than any other theory proposed during the last decade. According to the theory, an electrolyte, when dissolved in water, and sometimes when dissolved in other solvents, is separated more or less completely into its ions.

The empirical basis for the theory lies in the correspondence between electrolytic conductivity and the divergence from the normal depression of the freezing point and lowering of the vapor pressure; in the correspondence of both with the "avidity" of acids which has already been referred to; in the quantitative connection between each of these and the chemical effect of acids as shown in the inversion of cane sugar and saponification of methyl acetate; in the satisfactory explanation which it gives for the independent migration of ions during electrolysis as established by the work of Hittorf, Kohlrauch and others; in the fact that an electrolyte obeys the same law for dissociation with increasing dilution as a gas under diminishing pressure, first pointed out theoretically by Ostwald and Planck [3], and then experimentally established by Ostwald, Wilderman [4], Loomis [5]

*Abstract of an address before Section C of the A. A. A. S. (Buffalo meeting.)

[1] Ostwald's Lehrb. d. Allg. Chem. II., 647.

[2] Zeit. f. Phys. Chem **1**, 637 (1887).

[3] Zeit. f. Phys. Chem., **2**, 36 and 270 (1888); **3**, 170 (1889).

[4] *Ibid.*, **15**, 356 (1894); **19**, 243 (1896).

and others; and, in general, by the fact that the properties of a dilute solution of an electrolyte are dependent on the sum of the properties of the ions present rather than on the properties of the chemical compound which those ions may combine to produce. It would take me too far to illustrate this last statement as shown to be true of the density, color and other properties of solutions.

The theory has thrown light upon many chemical riddles and has placed the chemist in a position to predict phenomena which formerly could be known only as the result of experiment. It suggests at once the distinctions between the reactions of ions and reactions of bodies which do not undergo ionic dissociation. The former take place in solutions at ordinary temperatures and so instantaneously that the time factor cannot be measured; the latter frequently require an elevated temperature and are sometimes very slow. The distinction is perhaps a practical rather than a strictly logical one, for theoretical considerations lead us inevitably to the conclusion that only additive reactions, and in many cases not even these, can take place without a previous dissociation of some sort. In this view the distinction between the ionic reactions and others is that in solutions of electrolytes, a considerable portion of the compounds have undergone dissociation. and as any ion is removed by precipitation, or otherwise, the remainder of the compound of which it is a part undergoes rapid dissociation owing to the resulting dilution of the solution. In such cases the dissociation appears to take place almost exclusively at one point in the compound, and the reactions are clean and practically quantitative. It may be called non-ionic reactions; on the other hand, the initial dissociation appears to be trifling, and notably with organic compounds, may take place at several points; the reactions between the resulting parts must be slow and may give rise to a variety of compounds.

It is not alone in chemistry that the theories of osmotic pressure and of electrolytic dissociation have proved of practical value. Nernst has developed from these theories a theory for the cause of the E.M.F. in batteries, which, while it may not, as yet, have received general acceptance, is a more useful expression for our present knowledge than any previously proposed. The most important conception at the basis of this theory is that of what may be called a solution pressure for metals, corresponding in some sense to the vapor pressure of liquids. When zinc, for instance, is in contact with water, or an aqueous solution, this solution pressure is a force impelling the atoms of zinc to pass into solution. In order that they may do so, however, each atom must pass over into the state of an ion; that is, it must receive a charge of positive electricity which is carried with it into the solution. But only a very few atoms can pass into solution before the negative charge left in the mass of the zinc in proportion as the positive ion separate from it will cause such an accumulation of zinc ions in proximity with the zinc as to balance the solution pressure. If, however, an opportunity is given for the escape of the negative charge from the zinc and at the same time positive ions are allowed to escape from the solution at some other point, the zinc will continue to dissolve and currents of electricity will be set up. Thus, in the Daniell or gravity cell, zinc ions pass into solution, and a corresponding number of copper ions are deposited. The force which causes the movement of the ions and with them the transference of electrical energy within the cell is mainly the very high solution pressure of the zinc as compared with that of copper. Other factors, such as the osmotic pressure of zinc ions already in solution, which tends to counteract the solution pressure of the zinc, the osmotic pressure of copper ions which aids in the separation of the copper, and the different velocity of translation for various ions which may cause differences of potential when the fluids of the cell are not homogeneous, are most of them comparatively small in their effect.

No means have been found for the direct determination of the solution pressure of metals, but it may be calculated from the difference of potential between a metal and a solution of one of its salts. Methods for the determination of the latter have been devised by Ostwald[6] and improved by Paschen[7]. By the use of these and other constants which the researches of physical chemistry have placed in his hands, the physicist can now calculate the E. M. F. which can be obtained by various combinations of metals and solutions. On this side the theory has rendered essentially the same service for the galvanic cell which the atomic theory rendered for chemical compounds when it furnished the means for calculating their percentage composition. As in the early days of the atomic theory, many of the constants in question are imperfectly known, but since the theory has shown clearly their interdependence, new means for their determination and for the control of their accuracy are constantly being discovered.

Every one who is familiar with the extremely wasteful character of all processes now at our disposal for the transformation of chemical into mechanical energy must have had the thought that there is surely some means of saving a part of the enormous loss. At present the attention of the scientific world is turned toward the transformation of the chemical energy of coal into electrical energy as the probable solution of this problem. It seems to be almost certain that physical chemistry has already made clear the principles by means of which such a transformation may be accomplished. Indeed, Dr. W. Borchers,[8] by the use of a solution of cuprous chloride with producer gas, or carbon monoxide on one side and air on the other, has already obtained an electrical current which corresponds to a transformation of 30 per cent. of the chemical energy into electrical. This is an efficiency three times that of the best steam engines. There is no probability that this method can ever be practically useful, but that a practical method will soon be discovered is at least possible.

I have thus far spoken of the achievements of physical chemistry mainly in the direction of the development of the theories of osmotic pressure and of electrolytic dissociation. It is in this field that the most valuable practical results have been secured, because it is here that a new, far-reaching and extremely useful theory has been developed. But work in physical chemistry has been extremely active in many other directions as well.

I will not take the time to refer in detail to the work of Brühl and others on the refraction and dispersion of light as dependent on the composition and structure of bodies; to the work of Thomsen, of Stohman and of Berthelot upon thermo-chemistry; to the work of Guye, Walden and others on specific and molecular rotation, and of Perkin on electromagnetic rotation of polarized light, and to the work of Rowland on spectrum analysis.

[6] *Ibid.* **15**, 365.
[6] Zeit. f. Phys. Chem., **1**, 583 (1887).
[7] Wied. Ann., **41**, 42, (1890).

The Tennessee Centennial Exposition.

On the night of Aug. 20, the official test of the incandescent lighting of the Auditorium and Womans' Building at the Tennessee Centennial and International Exposition, Nashville, Tenn., was made under the direction of J. W. Braid, chief of the Department of Electricity. The Auditorium will be lighted mainly by arc lamps, but enough incandescent lights have been provided to illuminate the building in the event of the failure of the arc lights. The test demonstrated that the incandescent light was sufficient for all ordidary purposes. The Womans' Building was lighted with 230 lights, or one third of the total. They are arranged in four circuits, any one of which will supply light enough for ordinary requirements. A small night circuit is provided for the night watchman's use.

The Exposition will open on May 1, 1897, and continue for six months thereafter. The various buildings are well advanced toward completion.

Party Telephone Lines.

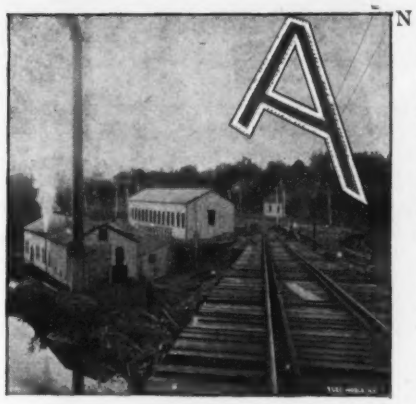
It is stated that the party telephone system has not been a general success in Boston, as far as public appreciation is concerned. Insome suburban districts, however, it seems to meet with favor. The principal reason given for the lack of popular support of this system is the frequent ringing of the call-bells, and the mistakes that naturally result where from two to five instruments are connected to the same line. Physicians and attorneys were at first the most liberal users of the system, but the favor from this class has disappeared, and the system is giving place to the measured service system. By the measured service is meant the system of limiting the number of calls for a certain price.

An Orange Battery.

Our contemporary, the London *Electrician*, states that Mr. Trotter, in a recent lecture before the South African Philosophical Society, plunged a steel knife and a silver fork into an orange, forming a battery by which he was able to send signals over one of the long-distance telegraph lines to Port Elizabeth from Cape Town, including a resistance composed of a row of persons joining hands.

[8] Ber. d. Deut. Elektroch, Ges., (1894).

The Akron, Bedford & Cleveland Electric Railway.



AN electric railway connecting Cleveland with Akron combines several novel features worthy of a more extended description than space here will permit. We will attempt, however, to present the chief characteri tics of this system.

The length of the road is about 38 miles, and runs from Cleveland to Akron by way of Bedford. The cars start from the Cleveland public square and run over the old Broadway & Newburg line, now a part of the Cleveland Electric Railway Company's system, to the terminus and then upon the new line, which is built in accordance with regular steam railway practice.

The arrangement that the Akron, Bedford & Cleveland Company has with the Cleveland Electric Railway Company is rather unique. After the cars enter Cleveland upon the local electric railway company's lines, the A., B. & C. conductor and motorman leave the car and transfer it and its passengers to the local railway company's employees. These men take it to the public square and collect from each passenger a 5-cent fare, and also on such traffic as they are able to pick up on the way. Starting from the public square, they pick up passengers, either local or interurban, and collect from each a 5-cent fare as before and deliver the car to the A., B. & C. employees at the end of the line with its load of passengers. An arrangement is made whereby the A., B. & C. Company gets a certain percentage of the fare receipts. After the car strikes the interurban part of the system the registers are taken down and the fare transactions are made according to ordinary steam railway customs. A similar arrangement exists in Akron with the local railway company.

There are two power houses. One is located at Bedford and the other at Cuyahoga Falls. With the exception that the power house at Cuyahoga Falls is a brick building, the two are exactly alike in equipment and therefore a description of the power house at Bedford, which we give herewith, will suffice.

Bedford is situated about 12 miles from Cleveland, and Cuyahoga Falls is a somewhat less distance from Akron, the result being that each of the stations is approximately one fourth of the way from the termini of the road. A general view of the power house at Bedford is shown in the initial letter heading this article. This view, which also shows the car barns which are situated upon the upper level was taken from the top of the temporary bridge where the memorable accident of last Winter occurred. The bridge timbers and track will be seen extending from the foreground down to the power house. The power house is a wooden building and is supplied with coal by means of electrically hauled hopper cars which empty their loads at the little side track on the left of the car barns down into the coal shed below adjoining the boiler room. Soft coal is used and is fed to the boilers without any special attempt to coke it. The boilers are of the Stirling type, made by the Stirling Company, of Chicago, and have the well-known familiar fronts and siding, as shown in Fig. 1. They are fed with driven well water, which, however, causes no trouble due to scale. Two Davidson feed pumps and a single feed-pipe system suffice to supply the boilers without the use of injectors. The gaseous products of combustion pass to a 125-foot iron stack 3½ feet in diameter, which gives a very satisfactory draught. The steam is delivered by a single system of magnesia-covered steam piping, without intervening separators, to two engines of the improved E. P. Allis type. The chief feature of these engines is the valve gear, a view of which is shown in Fig. 2. There are two eccentrics which provide a constant release and compression. The wrist plates are suspended upon a spindle, which has an outboard bearing as shown in the figure, and the method of a stud and straight reach rod threaded through it with a handle and spindle to engage in a hole in the side forms the mechanical connection between these two members. The ordinary Reynolds crab claw and governor adjustment are used. The governor is belt-driven and is of the ordinary pendulum type provided with a dash pot. The engine slides and cylinder are cast together and bolted to the frame which connects them with the main bearing. The connecting rod drives a crank disc and turns an 18-foot fly-wheel, having a 33-inch face, carrying a 32-inch belt. The fly-wheel is cast in two parts which are bolted together. The stroke of the engine is 42 inches and its cylinder is 22 inches in diameter. It revolves at a speed of 87 revolutions per minute. There are two such engines and they both exhaust into a Berryman heater and from thence into the air. Each of the engines is belted at a distance of about 30 feet between centres to a Westinghouse generator; these generators are exactly alike, but are so interesting in their construction that they will be described at some length.

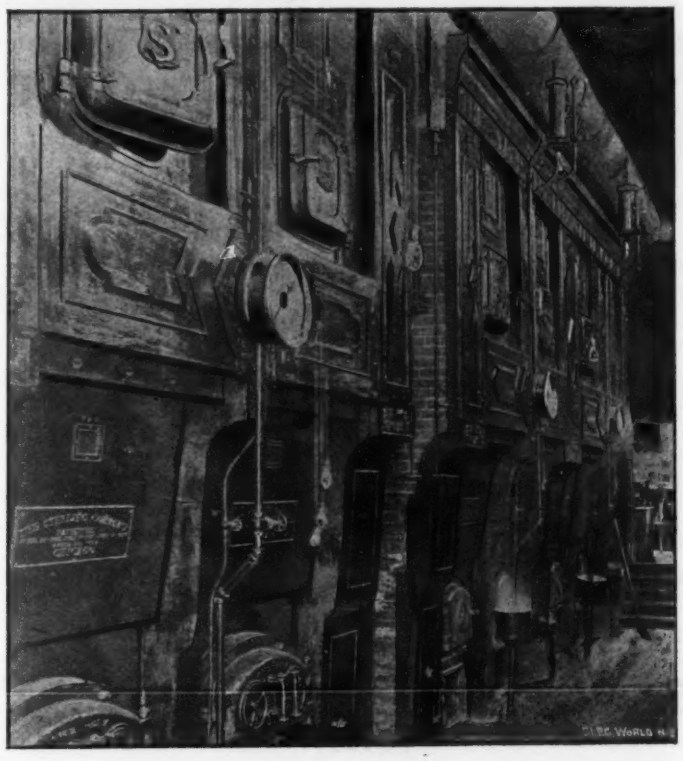


FIG. 1.—BOILER ROOM.

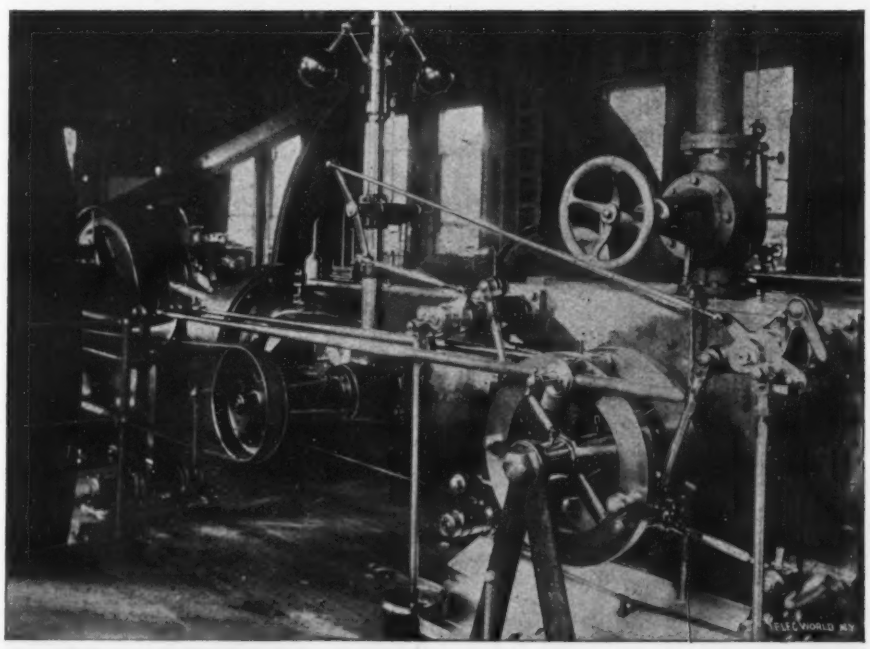


FIG. 2.—VALVE GEAR OF ENGINE.

They are two-phase machines with a distributed winding, and have

eight poles; they are also provided with a direct-current commutator, and at present are delivering their entire output of 350 amperes as direct current at 550 volts. In the rear of the generator will be seen the two-phase connections. There are four rings, one for each wire, which connect directly with the commutator rings after passing through the compounding coils on the spokes. These rings are attached at 16 symmetrical points on the winding. A rectifier is provided to energize the series coils should the machine be required to deliver its entire output as alternating current. The shunt

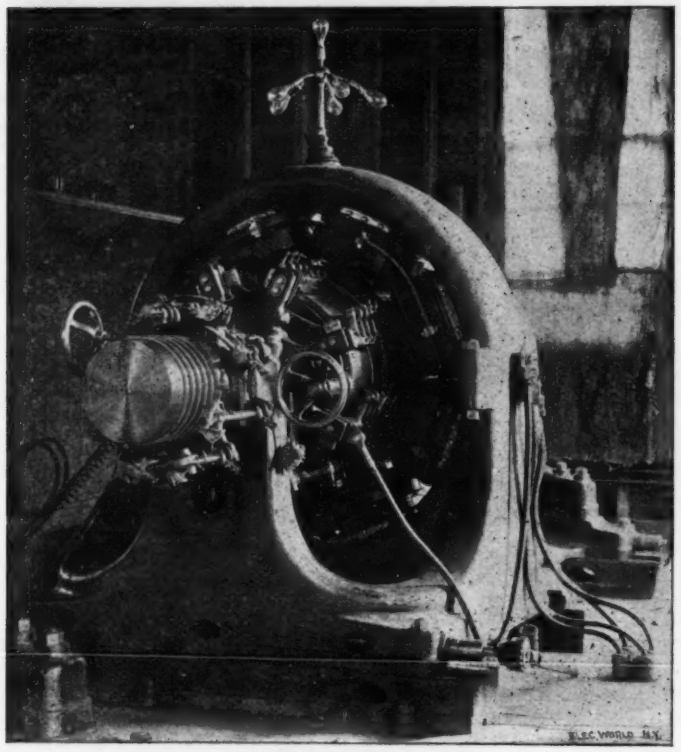


Fig. 3.—Generator, Commutator End.

coils, of course, would be excited from the direct-current commutator. Figs. 4 and 5 afford views of the front and back of the machine, showing the two-phase connections.

The original idea was to utilize the power of a distant water right, transmitting it by the two-phase system to the power house and use the generators as rotary transformers; and there is no reason why this will not be ultimately accomplished, but at present the machines are directly driven. They are provided with three bearings, the pulley being given an outboard bearing which greatly stiffens the entire machine. The bearings are self-aligning, self-oiling, and are

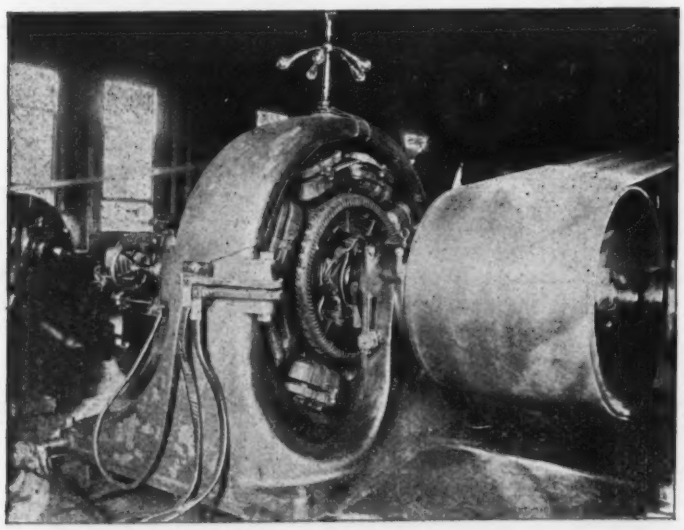


Fig. 4.—Generator, Pulley End.

cast in one with the base frame, the caps being put on by four bolts each. The outboard end-bearing is removable. The machine is provided with five lamps in the customary Westinghouse fashion. The brushes are fitted with a screw adjustment so as to be moved by a hand wheel operating through a pair of beveled gears. The frame is of cast iron, and the poles are of laminated wrought iron, the bobbins being held in place by screws in the ends of the field spools. The speed of the generator is 450 revolutions per minute. The machines run in multiple, and are connected by an equalizer wire, while the

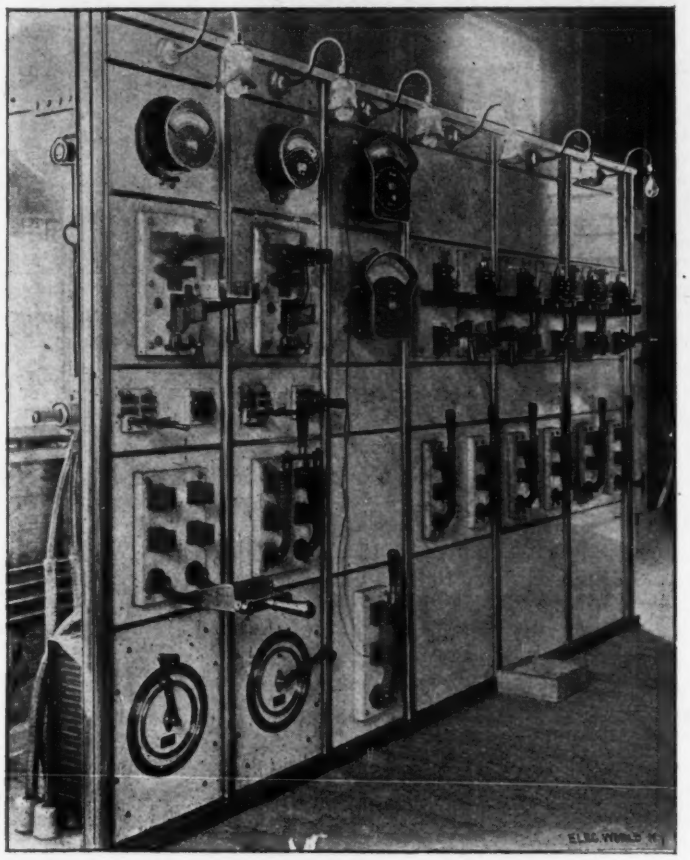


Fig. 5.—Switchboard.

power leads pass to the switchboard, the latter being shown in Fig. 5.

The switchboard consists of six panels, two of which are devoted to the machines, the third to instruments and the remaining to circuits. The machine panels are provided with a rheostat for controlling the output of the dynamo, a main double-pole single-throw-switch, a voltmeter switch, a lighting-switch, a circuit-breaker, the moving mechanism of which is placed at the back of the board, as will be noted in the figure, and a round type Weston ammeter. The instrument panel is provided with a voltmeter, a summation ammeter and a ground switch which carries the entire station load. The three circuit panels each carry two circuits, each circuit having

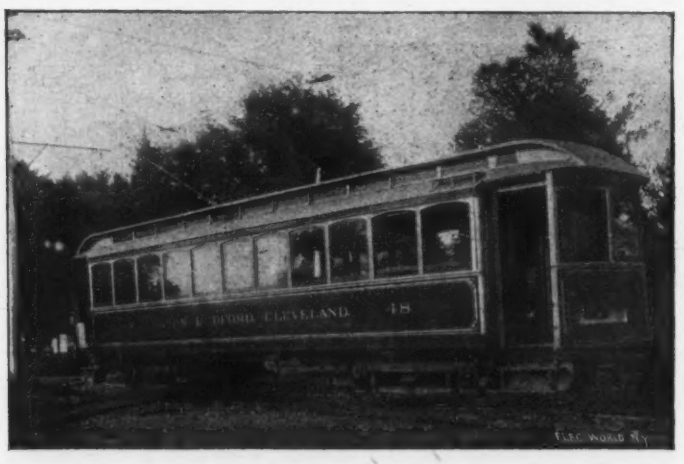


Fig. 6.—Car of Akron, Bedford & Cleveland Electric Railway.

a single-pole switch and a circuit-breaker. All of the panels are illuminated by incandescent lamps. The board is of white marble mounted in brass and presents the typical pleasing appearance of all Westinghouse switchboards. In the rear are Wurts tank lightning

arresters, kicking coils and other means for protecting the apparatus from electrical storms.

Of the six circuits provided for in the switch panel only three are in use. Two of them go south toward Akron and the other north to Cleveland.

The rolling stock consists of about 20 cars. The motors are Westinghouse, both of which are mounted on the rear truck. The trucks are by Brill and by Dorner & Dutton. The cars are provided with Hunt air brakes, whistles blown by compressed air, and are vestibuled in the same manner as the Cleveland & Elyria cars described in the last issue. An illustration of one of the cars mounted on Brill pivoted trucks is shown in Fig. 6, while the interior of the car is shown in Fig. 7.

FIG. 7.—INTERIOR OF CAR.

The car is provided with plush cross seats, closet, ice-water tank, and all the accessories of the ordinary steam railway equipment, and with its two 50-hp motors can easily attain 50 miles an hour.

The track construction consists of Johnson T-rails bonded together. The trolley wire is No. 0000. This means excellent contact with the trolley wheel and saves the installation of much insulated copper. Trains run between Cleveland and Akron every 40 minutes and the service is very satisfactory.

On the Relative Position of Engine, Dynamo and Switchboard.

The average consulting engineer considers that the arrangement of the switchboard relatively to the dynamos and engines is the most important part of the station design and calls for an unusual exercise of his ability and judgment. Such is indeed the case. The conditions which determine the position of the switchboard are many and conflicting. It is of course desirable that all the points of control, namely, the throttle, the switchboard and the commutator end of the dynamos, should be separated as little as possible. Trouble is likely to occur so that it is necessary to manipulate the devices at any or all of these places within a very short period of time. If the attendants of the station are limited in number, the management of an accident may depend upon one man, and unless he can act promptly and not be required to take a long run between the engine and the switchboard, the chances are that his efficiency in time of trouble will be very much curtailed. Having numerous attendants simplifies the problem so greatly that other conditions of inconvenience prevail to the complete exclusion of those just mentioned. Thus, in large stations, the switchboard has an attendant all the time and can therefore be placed upon a balcony in an elevated position where the dynamos and engines can be readily seen. Similarly, the engines are controlled by a separate gang of men, and it is only necessary to place them in such a position that the valves, throttles and other controlling devices shall be near together. The dynamo looked after by a third gang of attendants needs no special arrangement, but in a small station where the engine, dynamo and sometimes even the boiler-room is under the care of but one man, it will be seen at once that such arrangements are not suitable. While it is desirable to have the switchboard near the commutators of the dynamos, that position should never be secured at the expense of convenience to the throttle. Serious sparking at the commutator, although rapidly destructive, does not require the immediate attention that is needed for a belt off the pulley or water in the cylinder. Both of these accidents demand that the engine be shut down and the load thrown off the machines. Unless these two operations are accomplished at once serious results are sure to follow, so that the necessity for proximity between the throttle and switchboard is obvious. A common but grave mistake is to place the switchboard and throttle in such positions that while relatively near each other, the runway between the two points of control may be blocked by a serious accident. Thus in one case which came under the writer's notice a machine became short-circuited by improperly manipulating the switchboard, resulting in throwing off the belt. The engine quickly wound up the belt and began by thrashing the floor with it not only tore it into pieces but also blocked the way so that it was practically impossible for any one to reach the throttle. Had it not been that there was an attendant near the engine at the time it is probable that the problem would have been exceedingly complicated and much damage might have been done, for, as nearly as could be judged, the engine, thus suddenly relieved of its load, was fast attaining a dangerous speed. Situations in close proximity to the engine cylinder are frequently bad places to run electric wiring owing to the leakage of the exhaust pipes and similar conditions producing moisture. Therefore the leads to the switchboard should be very carefully insulated when it is necessary to place the board thus disadvantageously. For this purpose a vitrified pipe with well-cemented joints will be found very effective. The number of stations where this precaution in placing the switchboard has not been taken is surprising. The switchboard is usually considered as part of the dynamos and placed near them. but the advantage of placing the switchboard near the throttle far outweighs the other and more conventional practice. G. T. H.

The Failure of the Kings County Elevated Railroad.

On the morning of Aug. 31, 1896, the Kings County Elevated Railroad Company, of Brooklyn, went into the hands of a receiver.

The application was made to Justice William W. Goodrich and was granted.

The receiver, who was appointed by the common consent of all parties concerned in the action, was Gen. James Jourdan, the president of the company. This fact, taken with the other that he is also one of the plaintiffs, and, in a sense, the defendant, makes the suit in the nature of a friendly adjustment of difficulties rather than a partition at law.

The plaintiffs allege that the business of the company has fallen off through the introduction of the trolley system, and that they have been barely able to pay the running expenses. They also assert that the property has been assessed for taxation to such a figure that they are unable to meet their obligations to the City Government.

Most of the creditors expressed willingness to compromise but the minority insisted upon either prompt payment or receivership.

The company is capitalized for $4,757,000. It cost $10,193,725 to build the road and equip it. The company has 145 passenger coaches, and the yearly operating expenses are said to be $705,000. Before the advent of the trolley car the road carried about 30,000,000 passengers a year, but latterly the receipts have been reduced 50 per cent.

The balance sheet of 1895 shows its assets to have been $15,630,947.82, and its capital $4,750,000. The funded debt, $9,745,950; current liabilities, $731,872.82; real estate and mortgages, $38,500; second mortgage bonds, $364,625. For the year 1895 profit and loss deficiency was $718,085.52; the gross earnings were $804,407.70, an increase of $62,177.70.

The company is bonded on first mortgage for $550,000 for each mile of track. The length of road is 8.3 miles.

Interest on company first mortgage bonds is $63,575, and a coal bill for $35,000 is due, but $5000 being in the treasury to meet these demands.

The bond holders are willing to extend time, but the coal dealers say no more coal shall be sold to the company unless the bill for $35,000 is paid and dealers had better credit than hitherto.

The banking houses of Belmont and Vermilyea have now practically got entire control of the system.

The receivership will lead to reorganization, and perhaps to a sale of the entire system.

The line will have to be operated every day whether money is lost or not, as required by the franchise.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS.

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating-Current Transformers. FLEMING. Lond. *Elec. Rev.*, Aug. 14; the conclusion of his last lecture (see *Digest* last week).—He discusses the employment of transformers; the method found most practical over a large area is to have the alternators feed into a common set of bus-bars from which the current is distributed to transformer substations, at each of which is placed a bank of transformers feeding a three-wire system, each transformer having three secondary terminals; in a bank of transformers it is important that each should have an equal percentage secondary drop for the same fraction of full load, otherwise they will not share the load equally and cause trouble; the most convenient plant for a provincial town having a dense and an outlying district is to have one or more low-pressure networks in the centre portion of the town forming a complete ring with the substations interconnected by high-pressure mains, although the secondary network should not be so connected, in order to limit the effect of a ground on one of them. Concentric cables are in all cases the most satisfactory, both for high and for low pressure, the triple concentric cables being used for the secondary network and the outer wire being made the neutral one; it is desirable to get rid of distribution and service boxes by making the proper connection to each house at the time the cable is laid, as it is only a question of time when every house will want the current; the secondary cable should be tested after it is laid, with 1000 volts and the high tension (if for 2000 volts) with 4000 volts for one hour between the cables and 2000 between the outer member and the earth. He discusses at some length the peculiar effects observed in connection with concentric cables when supplying transformers, which are as follows: The resistance effects concerning the distribution of the current over the cross-section, the capacity effects, the resonance effects due to the reaction of this capacity on the alternators, and lastly the effects depending on the capacity and the inductance, both of which co-operate, producing peculiar effects at the moment when the cable is connected to the circuit; a table is given showing the resistance of copper conductors for continuous and alternating currents, the frequency being 100; this shows that practically the largest conductor that should be used with alternating currents is one having an outside diameter equal to a 19/12 cable, for if it is greater the resistance differs sensibly from that for continuous currents; the maximum thickness (radial) of a copper conductor should not be more than about half an inch; in very large concentric systems the capacity current may amount to a considerable value; a cable may increase the pressure at the terminals of the alternator by a considerable amount, which he explains; the engineer must always be on his guard against this resonance effect; to prevent the failure of cables due to the peculiar conditions set up on connecting a cable with an alternator is to first connect the outer member of the cable to its bus-bar before the other one is connected; another remedy is to introduce in the circuit of the inner member a variable inductance which is afterward gradually removed, which can be done by means of a large transformer whose secondary is gradually short-circuited by a water resistance, the primary being in series with the inner member of the cable; in no case should long concentric bars be connected to bus-bars or other parts of a circuit without some such process.

Graphical Reproduction of Flux in Dynamos. *L'Elec.*, Aug. 8.—A brief, illustrated description of the method suggested by Merrill for representing the intensity of the flux in the air space; the results of the measurements of the flux at successive portions are plotted as radial distances toward the centre, from the inside surface of the pole-pieces, which surface is circular; the resulting diagram is a lozenge-shaped figure drawn in the space occupied by the armature, the radial distance between this figure and the inside surface of the pole-pieces representing the intensity of the flux at the various positions; in this way the change of flux due to a change in the position of the brushes may be readily shown.

Alternating-Current Machinery. DUBSKY. *Elec. Eng.*, Aug. 26.—A continuation of his illustrated description of some of the Ganz machinery at the Budapest exhibition. To show how well the machines are insulated a 1-hp three-phase motor was run for several hours a day under water with 300 volts; the rotary part has its winding short-circuited; the stationary part is wound with double-covered cotton wire, which is afterward insulated with a special paste used in all their machinery. Another three-phase motor of the same size was mounted on four spiral springs to show the absence of any irregular movement or vibration. The details of a 3-hp three-phase motor are illustrated, as are also a transformer junction-box and wattmeter. He describes a simple method for determining the slip in testing three-phase motors; any convenient arc lamp run by the same current is placed opposite one end of the shaft, which has a black disc on the end of it with a white line, which will be seen to revolve at a greater or less speed as the motor is more or less loaded, and it is quite easy to count the number of these revolutions, which is equal to the slip of the magnetic field.

LIGHTS AND LIGHTING.

New Incandescent Lamp. Lond. *Elec. Rev.*, Aug. 14.—A brief descriptive note referring to a lamp recently invented in Germany, which consists of an incandescent plate with platinum wire terminals enclosed in the usual vacuum bulb; it is made of pure asbestos fibre saturated with 30 per cent. platinum chloride solution, then passed through a saturated salammoniac solution, dried in the air and heated in a flame, which converts the surface into spongy platinum; it is then saturated in a 20-per-cent. magnesium-chloride solution and heated quite hot, this process being repeated until it is evenly covered; as the lighting capacity of the alkaline earth is about three times as great as that of carbon, considerable economy is expected; the manufacture of the lamp is comparatively cheap.

Train Lighting. *L'Elec.*, Aug. 1.—An illustrated description abstracted from a report by POHL on the system used in Germany for the mail cars, more than 1000 of which are now provided with electric lighting, using the Boese accumulator. The cost of electric lighting is less than that with gas from oil, the saving being 21 per cent.; the energy is charged for at the rate of 4 cents per kw (hour); for the energy and lamp the cost of a 12-cp lamp per hour is 0.2 cent, or, including everything, 0.8 cent, while that for gas from oil was 1.0 cent. Sixteen cells of accumulators are used in four units of four cells each, the total weight being 405 pounds; the charging and discharging current is 6 amperes, the capacity 120 ampere-hours, or 3.7 kw-hours; the cost of the installation on the car is appreciably less than that for gas, as is also the weight. A description is given of one of the charging stations near Berlin.

Negative Resistance. S. P. THOMPSON. Lond. *Elec.*, Aug. 14.—A brief reply to the recent statements of FitzGerald (*Digest*, last week).

POWER AND HEAT.

Electric Ploughing. *L'Elec.*, Aug. 8.—A summary of a recent report by Corling on experiments made at Diedrichshagen near Rostock, Germany. In all experiments made so far, continuous currents have been used but in this installation high-tension alternating currents are employed; the current is transmitted at 2200 volts over a distance of 2.1 miles with three wires, the power transmitted being about 37 horse-power; at the point of consumption the current is transformed down to 220 volts; the ploughing is accomplished by two fixed windlasses which can be moved in the direction of their axes; over these passes a cable to which the plough is attached; the windlass receives about 28 horse-power which is sufficient for a plough with four shoes which travels 300 metres in six minutes covering a width of 1.80 metres and ploughing a depth of 30 centimetres; in 10 hours' time 43,500 square metres can therefore be ploughed. As the power may also be applied to other purposes when not used for ploughing, the cost of 37 horse-power during 10 hours is estimated at about $8.25; the cost of the installation was $8250; for 120 days per year, allowing an amortization of 20 per cent., and including the wages of the five men required, the total cost of ploughing 43,500 square metres is $26.50; ploughing by means of horses costs at least double this amount; the advantages over steam are self-evident, the apparatus being lighter, less delicate and requires no transportation of combustible material to the field. The expense can be reduced still more if the ploughing is continued for more days in the year; he suggested that the power in beet sugar factories be used for this purpose while it is idle, which would still further reduce the expense.

Transmission of Power Plant at Lyons. ROUTIN. *L'Eclairage Elec.*, Aug. 8; the first part of an illustrated description of this plant; an introductory article describing the proposed installations was published in that journal May 2.—The transmission voltage is 3500, the wires being completely under ground and insulated with paper; the plant is composed of 16 units of 1250 horse-power each, the alternators having a vertical shaft and being directly coupled with their turbines; the three-phase system is used with a frequency of 50; the line voltage is generated directly by the armatures. Some of the characteristic differences between this plant and the one at Niagara is that the frequency in the

former is twice as great. With the Niagara current lamps can be run directly and the transformers become large and expensive. The advantages regarding the number of pole-pieces in favor of the Niagara plant are not of importance; the armatures are on the inside and not on the outside as at Niagara. The general appearance of the Lyons station is said to be more imposing. The diameter of the machine is 6 metres, instead of 4 as at Niagara, and the height is only 2 metres as compared with 4; there is an economy in the lines on account of the use of the triphase instead of di-phase system, besides the advantages regarding motors. A detailed illustrated description is given.

Transmission of Power from Chevres to Geneva. GUYE. *L'Eclairage Elec.*, July 25; the conclusion of the description of this plant (see *Digest*, June 27).—In the present portion are discussed the line and the distribution.

Overhead Traveling Crane. L'Elec., Aug. 8.—An illustrated description of one used at a large shipyard at Wallsend on the Tyne, Great Britain; it appears to be taken from Lond. *Electrical Industries.* The different movements are obtained with the aid of belts, from one motor; four speeds may be obtained.

Heating by Means of Electricity. Elec. Tech., July 31.—A note stating that a patent had been granted to LeRoy, of Paris, for the use of bodies containing silicum, which are heated to redness by the current; this material is a conductor of electricity which does not change in the air when brought to a red heat and which has a very high melting point, for which reasons it seems well adapted for electric heating.

TRACTION.

Disturbances Due to Strong Currents. WIETLISBACH. Lond. *Engineering*, Aug. 14; a brief report of a paper read at the Congress at Geneva.—He referred to the disturbances in telephone lines and chiefly to those due to railway currents (much of what was said has already appeared in these columns); the report is said to have been a masterly *resumé* of the subject. A distinction should be made between electromagnetic and electrostatic inductions; he recommends good bonding, feeders, return feeders and insulation of the track; it was thought that the vibration of the tracks was one of the causes, but he thinks that sand on the rails has more to do with it; the contact at the trolley and the rail was thought to be one of the causes, but the isolation of this particular cause has not yet been attained; it appears that the motor itself causes the chief current fluctuations; whether the disturbance was due to the feathering of the brushes or to the momentary short-circuiting, remains to be settled; no induction is noticed with an underground current-supply (apparently meaning conduits); at Lugano, where three-phase alternating currents are used, the disturbances were very strong when the rails formed the return circuits; the adoption of three separate wires proved a remedy; he considers this indispensable; he believes that most safety devices are worse than useless, as they encourage carelessness. In the discussion Kapp did not favor insulating the rails, which he thought would be dangerous; the use of small boosters had answered very well.

Nuckenbeuren-Tettnang Railway. Lond. *Elec. Rev.*, Aug. 14.—A brief, illustrated description of this railway in Wurtemburg.

Mont Saleve Mountain Railway. Elec. Eng., Aug. 26.—A brief description, accompanied by some illustrations, of this railway near Geneva; the total ascent is 4,000 feet; the road is about four miles long; the third rail contact system is used; it is a rack railway; 600 volts are used and there are two motors of 25 horse-power on each car.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Apparatus for Limiting Currents. FRENE system. *L'Elec.*, Aug. 8.—A short, illustrated description of this apparatus, the object of which is to limit a current to a pre-determined maximum, and is intended to be used among other things for lighting installations not provided with meters, to prohibit a fraudulent increase of the current. It acts so that if the maximum current is exceeded, a resistance is automatically inserted through which the fall of potential is such that the light of the lamps diminishes as their number is increased. It consists of two electromagnets acting on the same armature, which, when attracted, opens the circuit through one of them through which the main current passes and which operates when the current exceeds the pre-determined maximum; the second magnet is connected as a shunt to the other, and when the circuit of the latter is open by an excessive current, the entire current passes through the second, holding the armature down and causing a considerable fall of potential in the main circuit; when the current is reduced to the normal the apparatus automatically establishes the normal condition.

NEUCHATEL. *L'Energie Elec.*, July 1 and 16.—A long description, accompanied by quite a number of illustrations and diagrams of this plant, in which water-power is used for supplying light and power to that city. Three-phase currents are used at about 3900 volts for power purposes, while for lighting there is an entirely distinct single-phase circuit at about 4050 volts; the capacity of the station appears to be about 1200 horse-power; one of the alternators may be made to give either three-phase or single-phase currents, the change being made rapidly; a complete diagram of the station connections is given; the length of the line is about 5.7 miles.

Notes on Polyphase Currents. GERARD and HENRARD. *Jour. Inst. Elec. Eng.*, July.—An abstract of some length of their recent paper abstracted in the *Digest*, March 21 (see also June 6). This abstract is reprinted (without acknowledgement of the *Journal*) in the *Elec. Rev.*, New York, Aug. 26.

Extensions to Outlying Districts. GIBBINGS. Lond. *Elec.*, Aug. 14.—A reprint of the Municipal Electrical Association paper abstracted in the *Digest*, July 11.

Lightning Arrester. OELSCHLAGER-SCHROTTKE system. *Elec. Eng.*, Aug. 26.—An illustrated description. It is very simple in construction, consisting merely of two uprights which are close together at their lower parts and diverge from each other widely at their upper parts (resembling in appearance the well-known Thomson form); one of them is connected to the line and the other to the ground; when the arc forms between the near portions it will be rapidly moved upward where the distance becomes greater until it is extinguished, this upward movement being due to the combined effect of the hot air currents produced and the electrodynamic actions of the currents in the stationary parts and in the arc; in order to produce this latter action the connections must be made at the lower ends of the uprights.

Central Station Statistics for Germany and Some of the Neighboring Cities. El'ty, Aug. 28.—A translation of the large tables noticed in the *Digest*, July 18 and 25; the present issue contains the first one, the rest of which are to follow.

WIRES, WIRING AND CONDUITS.

Combined Alternating and Continuous Currents. RUSSELL. Lond. *Elec.*, Aug. 14.—The effects following the superposing of a direct on an alternating current or the reverse, are very curious and deserve more attention than they have received; the theory is simple; the most important practical property of the combined currents flowing in one conductor, is that each produces its own heating effect practically independently of the other; this he proves algebraically; a direct current of 28 amperes combined with an alternating one of 29 amperes would produce the same heating effect as a direct or alternating current of 40.3 amperes; this important result points to a possible economy in the mains, for a combined plant; he refers to a plant at Brunswick, Me., (U. S.) where this has been made use of; a Brush arc light machine and an alternator have their return circuit in common, which costs less than to have a return circuit for each; two cables of 1 square inch each could in this way be replaced by one having a cross-section of 1.4 square inches, the power lost by heating and the drop in voltage being then only five-sevenths of what it was; this combination does not bring about any serious rise of pressure which might be feared; an alternating voltage of 100 superposed on 1000 direct would give only an effective pressure of 1,005 volts; in this system there will be a slight leakage of each current through the rest of the other circuit, but it will be slight and need not affect the working of the lamps or motors; he discusses their effects; if there are three currents in a conductor, one direct and the other two alternating, differing in phase by 90 degrees, then the three currents are quite independent of one another and if one is increased the increase in the heating is due merely to this increase of that one current; if the three currents had a value of 100 amperes each, the effective value of the combined current would be only 173.2 amperes, hence combining direct and polyphase currents may lead to possible economies.

ELECTRO-PHYSICS AND MAGNETISM.

Röntgen Rays. J. J. THOMSON. Lond. *Elec.*, Aug. 14; a long abstract of the Rede lecture; a brief abstract is published in the *Elec. Eng.*, N. Y., Aug. 19, and a longer one in *Elect'y*, N. Y., Aug. 19 and 26, which latter includes some of the illustrations.—It is interesting reading, is of a general character, but appears to contain nothing new. Polarization is an indispensable evidence of transverse vibration, hence the experiments to find whether polarization exists; the results are somewhat conflicting; it does not follow, however, that they cannot be polarized, as the methods for polarizing one kind of light may not be successful when used for another; it is possible and likely that the structure of the tourmaline, though fine enough to polarize light, may not be fine enough for Röntgen rays. He refers to the rays discovered by Becquerel, which resemble the Röntgen rays more closely than light and form a link between the two; it seems that under the influence of sunlight some chemical or physical change occurs and the substance gradually goes back to its original state when the light is cut off, emitting this peculiar radiation; Stokes has shown that light emitted by a phosphorescent body has a longer wave-length than that causing the phosphorescence; but in the case of Becquerel, the phosphorescence of the light emitted has a shorter wave-length than the incident light; it resembles an experiment by Tyndall in which a body placed in the focus of dark radient heat becomes luminous, giving out the shorter waves; it may be concluded from Becquerel's discovery that besides the vibrations emitted by luminous bodies there are others of much greater frequency, possibly arising in a different way. Although there is no direct evidence that Röntgen rays are a kind of light there is no property of these rays which is not pos-

sessed by one or other form of light; the fact that the absorption varies as the density, favors Prout's idea that different elements are compounds of some primordial element and that the density is proportional to the number of these atoms; there seems considerable evidence that the energy of the rays is small; he knows of no effects produced by them which involve energy comparable with that emitted in a second by a candle; there is no appreciable effect on the combination of hydrogen and chlorine, which is a good test for the intensity of very faint light; the rays do not possess the destructive effects on bacteria which are associated with ultra-violet light; the effects on the eye may be due to the straining to see faintly luminous bodies; the property of transmitting electricity, that is of making insulators conductors, is referred to and his experiments are described; curves are given connecting the rate of leakage with the voltage, showing that in gas it first obeys Ohm's law and is finally independent of the voltage, the curve being similar to the well-known curve of magnetization; his experiments with the discharge through solids are referred to at some length; the conductivity of paraffine for instance under these rays resembles that of an insulating sheath of a telegraph cable. As Röntgen rays greatly modify the properties of bodies, they promise to be of the greatest service in investigating some of the properties which are now most urgently pressing for explanation.

Notes on the Nature of X-Rays. Goldhammer. *Jour. Inst. Elec. Eng.*, July.—An abstract of some length of his recent article from *Wied. Ann.*, Vol. 57, No. 4 (see *Digest*, May 23; also June 13, where a briefer German abstract is referred to).

X-Ray Tube. Lond. *Elec. Rev.*, July 17.—A brief, illustrated description of the one made in Germany, described in the *Digest*, June 27.

The Absorption of Cathode Rays. Lenard. *L'Eclairage Elec.*, Aug. 8; abstracted from *Wied. Ann.*, Vol. 56, page 254.—An abstract of some length giving a summary of the results; the absorbing power was found to be approximately proportional to the density for the same kind of a cathode ray, whatever be the physical state or the composition of the medium. (A brief English abstract was referred to in the *Digest*, July 18.)

Electric Discharges in Rarefied Metallic Vapors. Wiedemann and Schmidt. *L'Eclairage Elec.*, Aug. 8; abstracted from the *Wied. Ann.*, Vol. 57, page 454.—A brief description is given of the color phenomena produced by various vapors.

Experiments on the Globular Spark. Righi. *Jour. Inst. Elec. Eng.*, July.—A continuation of the long abstract of his recent series of articles (see *Digest*, July 25).

Conductivity of Concentrated Sulphuric Acid. Guthe and Bangs. *Jour. Inst. Elec. Eng.*, July; abstracted from *Beiblätter*, Vol. 20, No. 4.—They came to the conclusion that all the curves have a minimum at the same molecular volume of 32.1; the molecular volume and not the concentration determines the conductivity; the temperature coefficient increases as the conductivity decreases.

Comparison of Electrical and Thermo-Conductivity of Alloys. Van Aubel and Paillot. *Jour. Inst. Elec. Eng.*, July; abstracted from *Beiblätter*, Vol. 20, No. 4.—They experimented with alloys having a high resistance, comparing the conductivities with cadmium; some of the results are given in the abstract; the law of Weidemann and Franz does not hold for alloys with high specific resistance.

Magnetization of Alloys of Iron and Antimony. Weiss. *L'Eclairage Elec.*, Aug. 8.—The first part of an article describing researches, the object of which was to establish a transition between slightly magnetic and very magnetic bodies, and thereby to follow the gradual developments of the properties of the latter; most of the slightly magnetic materials take a magnetization proportional to the field, and have no residual magnetism, while very magnetic bodies do not magnetize proportionately to the field and show the phenomenon of residual magnetization; he intends to find whether the two manifestations are connected with each other; in the present portion the method and apparatus are described.

Reflection of Röntgen Light from Polished Speculum Metal Mirrors. Blythswood. *El'ty*, Aug. 12.—A brief abstract of a Royal Society paper; experiments are described and the apparatus illustrated, which induce him to believe that the X-rays can be reflected; a lead screen with a hole through it is placed under the bulb and below the hole is placed a speculum-metal mirror at an angle of 45 degrees; facing this and parallel with the original rays is placed the photographic plate and the object to be photographed, enclosed in a zinc box with an aluminum window where the rays are to enter; a number of objects were photographed in about 20 minutes.

The Röntgen-Ray Discovery. Kolle.—A reprint under separate cover of a lecture on this subject delivered before the Long Island Medical Society of Brooklyn, June 2; it covers the subject in a general way, referring frequently to results that have been published.

ELECTRO-CHEMISTRY AND BATTERIES.

Sterilizing of Water by Means of Ozone. Repin (of the Pasteur Institute). *Rev. Gen. des Sc.*, July 15.—A descriptive article describing the apparatus used and the results of experiments; he also gives an estimate of the cost; no general conclusions are given. Ozone is not only very energetic in destroying microbes, but is the only one which destroys itself spontaneously after having acted, without leaving any trace; as compared with sterilization by heating, it offers the advantage that it does not remove the air from the water and costs less; compared with filters it has the advantage of destroying not only the living germs but also organic substances dissolved in the water; the only difficulty is the construction of a suitable apparatus to produce it economically and this difficulty he thinks has been solved, referring to the apparatus at the Hygenic Exposition in Paris and the installation at Oudshoorn in Belgium. Ohlmueller discovered a matter of considerable importance, that when water contains organic materials in solution the action of the ozone will first be on this substance before it acts on the microbes, and it is for this reason that the destruction of the microbes is difficult in cultures containing organic material; this explains why some experiments do not succeed. The apparatus referred to in the article is that of Tindal, Schneller & Van der Sleen, which is illustrated; its characteristic is that the insulating wall between the two electrodes is completely done away with; to replace the resistance which it presents and which is necessary for the production of the sparks, a resistance is placed in the circuit, made of a cylinder of porcelain or glass filled with glycerine; in this way 50,000 to 100,000 volts can be used with a much better efficiency; in the old forms of apparatus the distance between the electrodes was only about two or three millimetres, while in the present it is increased to 100. A description is given of a complete installation in which the transformers generate 50,000 volts; the air to be ozonized is passed through a series of the ozonizers, being repeatedly cooled in a refrigerating apparatus; it is then passed through the water; another system has recently been tried with success, and consists in spraying the water in a chamber filled with the ozonized air, thus ensuring a more intimate contact; it is then possible to work with air containing "three to four times less" ozone; it costs less to ozonize five cubic metres to 2 per cent. than one cubic metre to 10 per cent., and this method is therefore the preferable one. The purification of drinking water by ozone has been carried out on a large scale at Oudshoorn, Belgium, for over a year; the water used here is a very polluted one, being absolutely unfit for use; in the first instance of contact of the water and the ozonized air the greater part of the microbes are killed, but a few offer resistance, and to kill these seven to eight minutes more are required; of 17 sample tubes 16 tubes remained sterile; other similar results are given, some being obtained with water artificially contaminated with certain microbes; it is concluded from these experiments that the most impure water from rivers can thus be sterilized with perfect satisfaction; no matter what the number or the quality of the microbes, the question is only to increase the amount of ozone and the duration of the contact. A table is given showing the analysis of water in order to see whether the chemical constituents are acted upon; the principal gain is in the reduction of the nitrates; it was also found that ozonized water was much less readily reinfected than water which had been merely filtered; it is found that the beneficial salts in water are scarcely affected by the ozone; the color of the water as well as the odor and the taste are greatly modified, favorably; it was found that ozone did not introduce foreign substances into the water, such as those which are sometimes produced by a spark, nor were any traces of peroxide of hydrogen found in the ozonized water; there is no fear of the ozone remaining in the water, as it is very unstable; the water was found to be appreciably enriched with oxygen. Regarding the cost of the process, he gives only very general figures; it depends chiefly on the amount of organic material in the water and the price of coal; with the Seine water 600 watts per hour will answer for five cubic metres of water; a daily consumption of 300,000 cubic metres of water, as in Paris, would require about 3000 horse-power, which it is thought is not exorbitant; the ozone which is not used can be recovered by passing the same air through the apparatus again; the same machinery could be used for the production of light at night and for the sterilization of water during the day; ozone can also be used for many other purposes, and it might therefore be sold to advantage by the central station; the City of Paris is about to make a trial on a large scale, the plant being at present under construction at St. Maur; a similar plant is about to be erected at Antwerp and St. Petersburg.

Commercial Ozone. Andreoli. *L'Elec.*, July 25.—An article of a general nature calling attention to the general lack of definite knowledge on the subject of the production of ozone and pointing out the great difference between generating it in laboratories and in large quantities on a commercial scale; he considers most of the ozone apparatus mere toys; he summarizes a paper by Shenstone read before the Chemical Society and criticises unfavorably some of the conclusions; Andreoli believes that for the manufacture of ozone a high voltage and high frequency are required and not that the amount of ozone generated is independent of the voltage, as has been stated; he protests against the propagation of incorrect statements. He believes the number of commercial ozonizers is extremely limited and that there are probably not more than four.

Purification of Sugar. L'Eclairage Elec., Aug. 8; abstracts of several papers on this subject read at the recent International Congress of Applied Chemistry.—In one by Battut on the Purification of Sugar Liquors by Electrolysis, he gives a long list of researches which have been made by others and comes to rather pessimistic conclusions; they are unfavorable to the use of electricity for this purpose; he admits that

such purification is possible, but is too expensive. In a paper by BAUDRY he describes the application of the process of Schlomeyer, Behm and Dammeyer, showing that by means of electrolysis purification is simpler and more rapid, thus increasing the capacity of a plant; it was applied in 1894, at Stepanowska in Russia, where it was shown to be much more economical than the method with chalk, and increases the daily production of a plant 20 to 25 per cent., the results were confirmed by the chemist of a plant at St. Denis. PEYRUSSON protested against the use of lead in the manufacture of food products and suggested that the sugar liquor be limited to a central compartment separated by porous diagrams from the two compartments containing the electrodes. DUPONT had great confidence in the future of this new application of electricity; his own experiments showed that the method is perfectly practicable, the only objection being the cost; this is due partly to the large amount of energy absorbed by the polarization of the electrodes, which may be considerably reduced by keeping them quite clean; an objection to the process is that some of the crystallizable sugar is transformed into glucose, but this will not happen with a soluble anode and it may therefore be easily avoided.

Electro-Plating of Aluminum with Copper. MARGOT. *Jour. Inst. Elec. Eng.*, July; abstracted from *Beiblätter*, Vol. XX., No. 4.—The aluminum is cleaned in a warm solution of an alkaline carbonate; after washing, it is dipped into a hot solution of 5 per cent. hydrochloric acid and again washed, after which it is placed in a concentrated solution of copper sulphate until a uniform metallic deposit is formed; it is then washed and plated with copper in the same bath, with a current.

Electrolytic Nickel. Lond. *Elec.*, Aug. 14.—A note stating that a German firm is preparing nickel by electrolysis, using as a raw material a nickel-copper regulus containing 40 per cent. of copper and 30 of nickel, and working by a continuous cycle of operations which avoids the formation of waste liquors; details are not given.

Alumina Factory at Larne Harbor. SUTHERLAND. Lond. *Elec. Eng.*, Aug. 14.—A reprint of a paper describing the process used at this factory for obtaining pure alumina from bauxite.

Electrolysis of Metallic Sulphides. *L'Eclairage Elec.*, Aug. 8.—A brief description of the Siemens process, showing that under certain circumstances double sulphides of some of the metals can be formed, which has the advantage that the precipitates formed without diaphragms can be regenerated without using additional materials.

International Congress of Applied Chemistry. BOISTEL. *L'Ind. Elec.*, Aug. 10.—A general report of the proceedings of this congress, which was held in Paris in July; abstracts of some of the papers are given, all of which have been noticed in these columns under their respective headings.

Ozone-Producing Apparatus. ANDREOLI system. *Elec. Eng.*, Aug. 26; a brief, illustrated description.—It consists of a sealed cylindrical tube containing "more or less rarefied gases," and one of the terminals, which consists of a carbon filament, a bundle of serrated wires with radiating points, or some similar device; outside of the tube is an open coil of serrated wires, which forms the other electrode (it appears that the ozone is generated on the outside surface of the tube). Besides the bluish or violet glow of the silent discharge there is another luminosity quite distinct from it, but all that is said about it is that "in the vacuum tubes there is both the glow of the silent discharge outside (*sic*) and the luminosity inside," which is not very clear; it is called a new phenomenon "which differs as much from the disruptive discharge in an ordinary vacuum tube as the internal luminosity of the tubes differs from their external glow, and it is believed that nothing similar has ever been produced before." (This is presumably the apparatus referred to in the recent discussion in the Lond. *Elec.*, and it is to be regretted that the description is so unsatisfactory).

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometric Units. Lond. *Engineering*, Aug. 14; a brief report of the proceedings at the Geneva congress.—The long report of Prof. Blondel (who was not present himself) was referred to a committee consisting of Hefner-Alteneck, Arno, Hospitalier, Janet, Kapp, Palaz, Rey and Rosseau; the discussion of the report was a very heated one; Blondel in his report stated that as photometric energy is not only a physical but a physiological quantity there is no need to attempt to bring photometric units into harmony with C. G. S. units; the symbols which he adopts are those of Hospitalier; he concludes that for standards there is a choice only between the Hefner amyl-acetate and the Vernon-Harcourt pentane lamp and that preference must be given to the former; the American proposal to use an incandescent block of carbon whose temperature is determined exactly is not sufficiently definite; he recommends abolishing the name "bougie decimale," but the new name which he proposed, the "pyr," did not find favor with the committee. The report of the committee differed in several respects from Blondel's proposals; the proposals of the committee and the changes made by the meeting are given briefly; the photometric quantities are to be based on the luminous intensity of a punctiform source of light; the intensity of light is to be represented by an I and unit, being the bougie decimale; the flux of light by ϕ, the unit being the lumen which is equal to the intensity multiplied by the solid angle of a infinitely small cone of light; illumination by E, the unit being the lux, which is equal to the lumen divided by a square metre; brightness, by e, the unit being a bougie decimale per square metre; the quantity of light by Q, equal to the lumen multiplied by the hours, the unit being the lumen-hour; the exact names were to be left to the different nationalities; "provisorily the bougie decimale could be represented, for industrial needs, by the horizontal luminous intensity of the Hefner lamp." The differences in the discussion concerned chiefly the bougie; Mascart objected that a congress in which neither American nor England were represented should try to introduce a new definition of the bougie; the Hefner unit was equal to 1.06 bougie decimale according to French determinations, and to 1.02 according to German; von Hefner did not claim any absolute accuracy for his lamp nor does he desire to make it a scientific standard; it was suggested that the Hefner standard should hold for some definite period unless new determinations confirmed the Violle unit; Kapp proposed to change bougie per square centimetre into bougie per square metre, which was adopted; the final adoptions were by no means unanimous but the results of this congress have no binding effect; many will use the amyl-acetate lamp until something better is available; "whether people prefer to express their results directly in such units or to introduce a very uncertain effect is a question of taste."

Magnetic Units. Lond. *Engineering*, Aug. 14; a brief report of the proceedings at the Geneva congress.—The units proposed by Hospitalier were almost universally declined; he recommended the suggestions made by the American Institute. Ferraris thought these units neither necessary, useful nor well chosen; there was no unit for density (specific gravity) for instance, and the term atmospheres had long ago been replaced by kilograms per square centimetre; Kapp joined in the protest; he was content with ampere-turns; Mascart concurred; Helmholtz was said to have voted against the "weber," as it threatened confusion; only practical units should have names of eminent men; no units or names were adopted.

Modified Apparatus for Demonstration. LAROUSSE system. *L'Elec.*, July 25; a short, illustrated article.—In using the classical apparatus of Ampere for showing the action of currents on each other and toward a magnet by means of suspended frames, a powerful battery or other source is required, and there is considerable friction at the pivots through which the current must be passed; the present modification is to overcome these objections. He uses a short-circuited frame suspended by a silk thread, the lower part of the frame being made of a bar of copper soldered to one of German silver, thus forming a thermo-electric couple with a joint in the middle, below the point of suspension; a Bunsen flame is then placed underneath this junction, which will generate sufficient current in the short-circuited frame to operate the apparatus; a piece of moistened paper may be placed around the far end of the German silver bar in order to keep it cooler; the same principle may be applied to the other forms of this apparatus; for the astatic system the German silver rod forms the axis, and is soldered perpendicularly to the copper rod which constitutes the lower part of the rectangle, thus forming two couples.

Measurement of Surface Conductivity of Glass. KRUMMENACKER. *Jour. Inst. Elec. Eng.*, July; abstracted from *Beiblätter*, Vol. 20, No. 4.—He made absolute measurements of the electric surface conductivity of glass with different degrees of moisture of the surrounding air; the Siemens condenser method was used; the results for the same glass showed great variations, due to foreign influences, showing that glasses from different sources naturally differ much from one another; the resistance of the surface of a strip of lead glass of 1 sq. cm. is 6000 megohms and of soda glass 700; the natural surface of solidified glass in moist air is less conductive than a polished surface and much less than surfaces produced by grinding or by fracture.

Localizing Faults in Electric Light Mains. RAPHAEL. Lond. *Elec.*, Aug. 14; a continuation of his serial.—He discusses localizing without a return wire, describing a number of different methods; he begins the description of loop methods used without disturbing the connections more than is necessary.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Choice of Telephone Translators. PIERARD. *L'Elec.*, Aug. 1.—He defines a translator as a simple induction coil used for connecting the lines of single wire subscribers with double wire along distance circuits. There are a large number of different types, but from the point of view of the telephonic effect, they are all equivalent for long distances; for short distances those with a closed magnetic circuit or with a high electric efficiency give the best results. The conditions under which translators are used are quite different from those under which the ordinary transformer is used, the frequency being several thousand per second and the currents in the secondary several micro-amperes, the primary currents furthermore being intermittent as distinguished from alternating; the telephonic effect is the result of the efficiency, the sensitiveness of the receiver and of the ear; the efficiency may be as high as 90 per cent.; less is known regarding the sensitiveness; this is greater if the charge is very small; at a certain point it diminishes and ought to become zero

when the magnet is saturated; before this limit is reached the variations in the current produce no audible effect, showing the important part taken by the ear; according to the law of Fechner the intensity of the sensation perceived is the logarithm of the intensity of the cause producing this sensation; thus if the cause were 10 times greater, that perceived would be only 1.33 times greater; the telephonic effect of translators is independent of their construction for long distances, but the calling currents must also be considered; the efficiency then becomes quite important; he concludes that those having high electric efficiency, with a closed magnetic circuit, are preferable.

Apostoloff Automatic Telephone System. Lond. *Elec. Eng.*, Aug. 14.—A very brief description, without illustrations, of this automatic system, invented by Berditschewsky; a subscriber can connect himself with any or all of the others without the need of a central station; the general idea is said to be an excellent one, but doubt is expressed whether it could be relied upon commercially; the inventor claims that about $16 per subscriber will cover the first cost.

Budapest International Telegraph Conference. Lond. *Elec.*, Aug. 14; a brief report.—The discussion of compulsory use of the vocabulary occupied nearly two days; it was unanimously adopted that, from a day to be fixed by a future conference all the words used in private telegrams in code language shall be taken from the augmented official vocabulary to be prepared by the International Bureau. The next conference is to be held in London in 1901.

Telephonic Communications Between Light Vessels and the Shore. Stevenson. Lond. *Elec. Rev.*, Aug. 14.—A brief description of the Blake system, which was used successfully with a vessel off Sandy Hook.

Military Telegraphy in Italy. L'Elec., Aug. 8.—The last installment of the long, illustrated serial which has appeared in this journal.

MISCELLANEOUS.

Geneva Exhibition. Lond. *Elec. Rev.*, Aug. 14.—A brief, descriptive note with an illustration of the inside of machinery hall. In a small electric railway for use on the grounds, the two rails are used as the two leads, there being no other insulation than the ordinary sleepers; the leakage current for this short line is 30 to 50 amperes, although the voltage is only 100. A continuous current generator is exhibited intended for the plant at the Chaux de Fonds, where the voltage will be 14,400, the current being 120 amperes, which is to be kept constant; the drop in the line at full load will not exceed 4.6 per cent.; all the motors will be placed in series and will be carefully insulated; a full account of this remarkable plant is promised.

International Congress at Geneva. Lond. *Engineering*, Aug. 14; a continuation of the report of the proceedings.—The official list showed 246 members, among which the French and Italian predominated and engineers were in the majority, the professional element being less strongly represented; the questions of disturbances due to strong currents, and of photometric and magnetic units are reported upon (see abstracts under the respective headings).

Medical Application of Electricity. Vigouroux. *L'Elec.*, Aug. 8; an abstract of an Academy note.—Referring to the recent communication of d'Arsonval (see *Digest*, Aug. 22) he points out the successful application of static electricity, giving the details in a case of diabetes; he intended to show that static electricity can be used instead of the Tesla currents, of which too little is as yet known regarding their physiological properties, for which reason their application is not free from danger, particularly in cases of heart trouble or large veins.

Currents for Therapeutics from Lighting Circuits. Meylan. Lond. *Elec. Rev.*, Aug. 14.—A translation of the article describing a universal transformer abstracted in the *Digest*, July 25.

Instruction. L'Elec., July 25.—A reprint of the curriculum of the trades school under the direction of the International Society of Electricians in Paris.

Magnetic Chucks. Amer. Mach., July 16, 30 and Aug. 13.—Illustrated descriptions of various forms of the Walker system for holding articles of iron and steel on lathes, planers, etc.; the magnet is of peculiar construction, so as to cause many short lines of force to pass through the metal to be held; the current is taken from the ordinary lighting circuit; to prevent the work from twisting over the surface, adjustable edges and stops are provided; a clutch for a drill press is shown, one of the advantages of which is the promptness of the release of the work; a chuck adapted for a surface grinder takes a little less current than one lamp; they are used largely in some shops.

Double-Acting Mercury Pump. Elec. Eng., Aug. 26; abstracted from *Elek. Anz.*—A brief description of the Baehr and Krueger system. It operates twice as fast as the ordinary hand pump and consists of two Toepler pumps connected together at the bottom and mounted on a vertical board, which is pivoted so that it can be rocked in a vertical plane; with this combination one pump alternately serves as the mercury reservoir for the other.

New Books.

Physical Units. By Magnus Maclean. Biggs & Company, 139-140 Salisbury Court, Fleet Street, E. C., London. D. Van Nostrand Company, New York. 147 pages, 6 diagrams. Price, $1.25.

This little work, after devoting some 100 pages to units, gives numerous tables on such subjects as wave lengths, wave frequencies, indices of refraction, critical temperatures and pressures, specific heats, electrochemical equivalents, specific resistances, resistance, conductivity, and weight of hard drawn and pure copper wires at 15 degrees C., specific inductive capacity, surface tensions, moments of inertia of symmetrical bodies and acceleration due to gravity at different places, etc.

The book is chiefly a reprint of articles contributed to the *Electrical Engineer*, London, in 1894. The author first describes the fundamental units, both British and French, giving the origin or derivation of the units of length, mass, weight, pointing out the distinction between the two latter. He then takes up the discussion of geometrical and kinematical units, including the absolute dimensions of a solid angle, curvature, tortuosity, velocity and acceleration, the dynamical units of momentum, force, work, energy and moment of a couple, moment of inertia, moment of momentum, activity, etc. The fourth general division includes the electric units, both the electrostatic and electro-dynamic, their origin and absolute dimensions and their measurement by their electromagnetic and electrostatic effects. The final division includes heat units.

The volume as a whole presents in a collective form matters always of value, and makes therefore a source of ready reference.

Something About X-Rays for Everybody. By Edward Trevert, Lynn, Mass. Bubier Publishing Company. 78 pages, illustrated. Price, 25 cents.

This little work is designed to meet the popular demand for plain information regarding the latest scientific discovery—that of Prof. Röntgen. It is intended for the general lay reader, and is devoid of technical language; therefore it ought to satisfy the call for such a work. It is well and liberally illustrated, and any one so inclined can construct much of the necessary apparatus for Röntgen-ray work by following the directions given. A short sketch of Prof. Röntgen's life and work are given, with a picture of the professor. The Röntgen-ray ground is well covered by this interesting little book.

Extracts from the Private Letters of the Late Sir William Fothergill Cooke, 1836-39, Relating to the Invention and Development of the Electric Telegraph. Edited by F. H. Webb. E. F. N. Spon, London and New York. Price, $1.00.

The contents of this book are described by its title, and their value lies chiefly in their being historical records of the invention and development of the electric telegraph. The work was produced by the authority of the Institution of Electrical Engineers (England), in the belief that it will prove of much interest in connection with the early history of the telegraph and its practical introduction in England by Sir William Fothergill Cooke and the late Sir Charles Wheatstone. In order to enable the reader to understand more fully the circumstances in which the letters were written, a short memoir of Sir William F. Cooke, by Mr. Latimer Clark, is printed in connection with the letters.

A New Terra Cotta Conduit System.

Ducts of terra cotta in banks of two, four, six and nine, are being produced and installed by Mr. John T. McRoy, 915 Chamber of Commerce Building, Chicago, Ill. This conduit is made of vitrified terra cotta and forms a thoroughly waterproof enclosure for the wire.

It is manufactured in six-foot lengths. The ends being lined up with dowels, cannot become displaced.

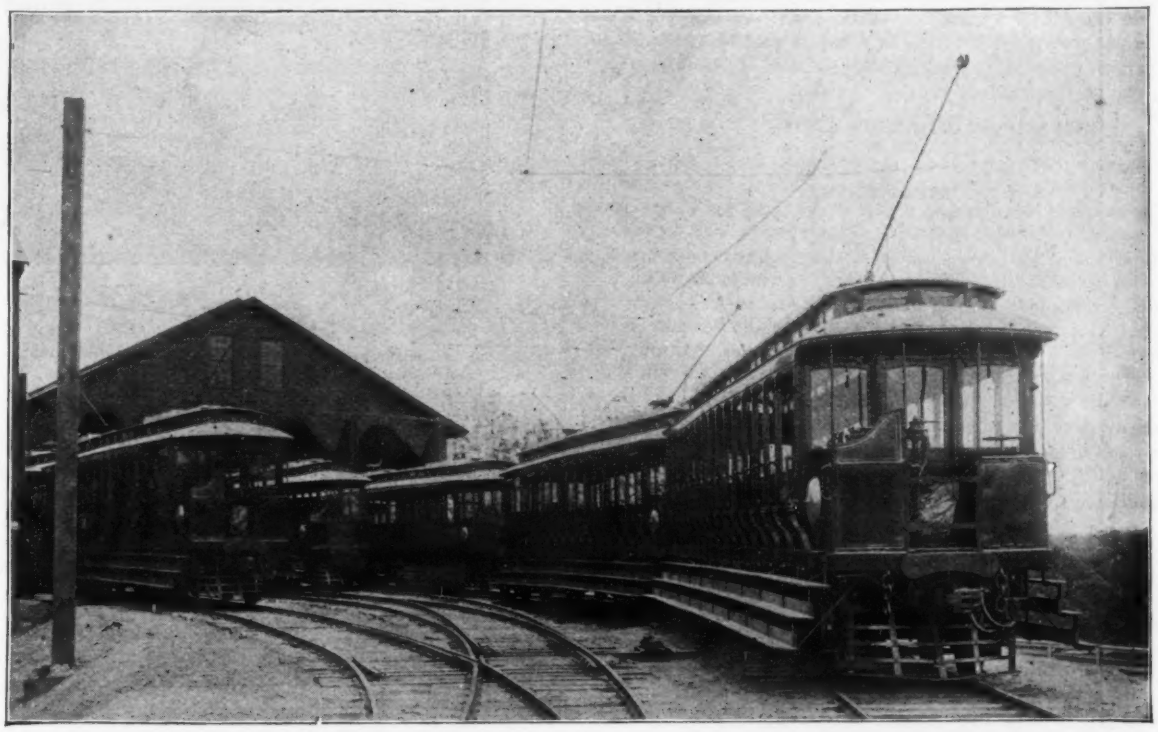
The joints are sealed with burlap, which is steeped in asphaltum by running it in long strips through a pot of the liquid mixture. It is then wound upon a reel, which is taken off when full. The burlap, while still sticky, is wound tightly around the conduit to the depth of five or six times. After it has hardened it is fully as strong as the original length of conduit and as thoroughly waterproof.

Machines turn out these conduits at a rapid rate, at the same time producing a very uniform product. The only perishable feature is its brittleness, but after it has been installed this is no longer a difficulty. Mr. McRoy has been installing large quantities of this conduit for railway, telephone and electric light companies, which is giving remarkably good satisfaction. It is inexpensive and requires no special tools to install it. The work of installation is no greater than that of installing a gas main, and when once laid the conduit is proof against rot and rust.

The Nantasket Beach Electric Railway.

The favor with which the electric operation of the Nantasket Beach branch of the New York, New Haven & Hartford Railroad has met from the visitors to Boston's pleasure resort at Nantasket Beach is phenomenal. The electric operation of the Nantasket Beach branch was in June last extended as far as East Weymouth, in the direction of Boston on the main line of the Old Colony road. On the new line, however, the overhead conductor is not used. A third rail laid between the rails of the surface track takes the place of the trolley wire, and the cars have been regularly operated over it between the regular steam trains with-

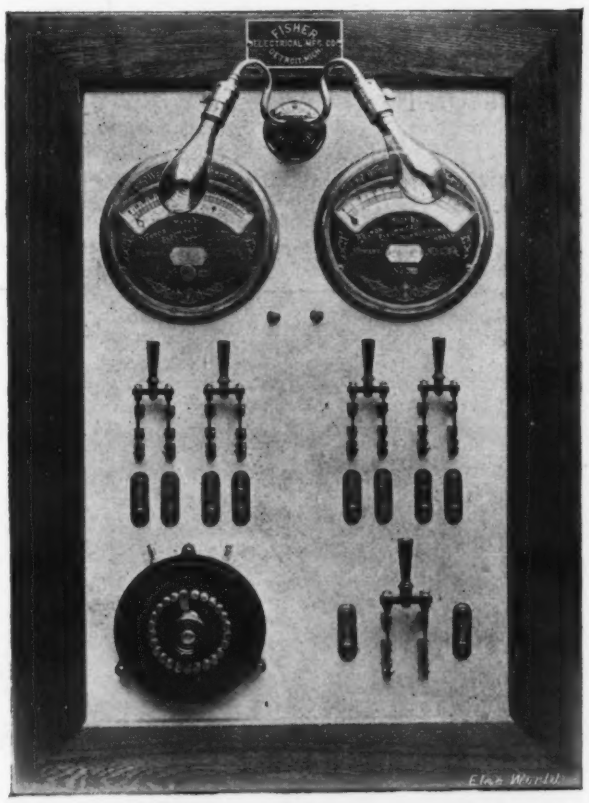
out hitch or difficulty. In the operation of the cars the change from the overhead trolley to the third-rail source of power is made imperceptibly. When the car approaches the end of the trolley-wire a knife-switch under the hood of the car is closed, connecting the shoe beneath the car with the motor circuit; the trolley slides off the overhead wire and is hooked down, the car meanwhile continuing on its journey. On the day of the inauguration of the third-rail section several high-speed spurts



CAR HOUSE, NANTASKET BEACH LINE.

were made, and these have frequently been exceeded in the actual service.

The illustration shows the car-house of the first electrical division of the New York, New Haven & Hartford Railroad, adjoining Power House



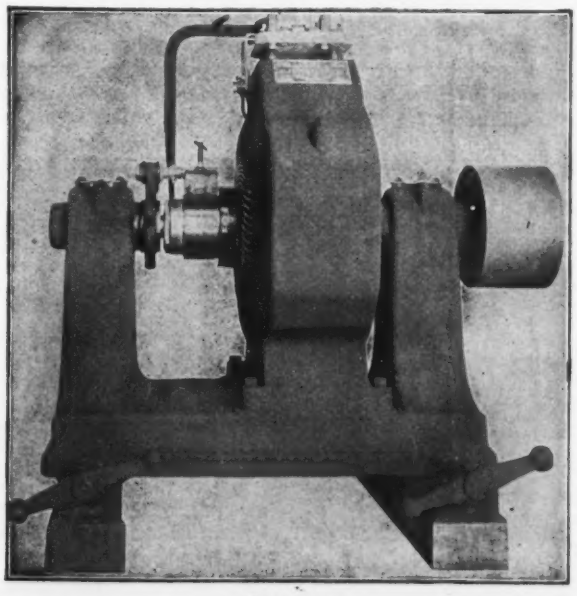
SWITCHBOARD.

No. 1, a corner of which is shown to the left. The car-house has four pits over which the car may be run for examination of the motors and is fully equipped with all the necessary appliances. The electric system used in this equipment is that of the General Electric Company.

New Dynamo and Switchboard.

The Fisher Electrical Manufacturing Company, Detroit, Mich., has just placed upon the market a new dynamo which embodies all the latest improvements in dynamo machinery. An illustration of this machine is shown herewith. The base frame is a casting of iron, both bearings thus being rigidly in line. The bearings are of the self-aligning type and are also self-oiling, thus conforming to the most approved practice.

The parts are made so that they are interchangeable. The field magnet is of a special quality of cast steel and is worked at such a low degree of saturation that its regulating properties are assured. The armature is built up of laminated plates and is of the toothed type. Separate coils of equal size, shape and resistance are used and the armature is therefore in perfect mechanical and electrical balance, and the necessity for extraneous balancing is very slight indeed. The coils are wound on the spiral end connector system. The machine has but two brushes placed at right angles to each other, although there are four poles, the winding therefore being of the wave type. This makes the machine of extremely slow speed and very durable. Carbon brushes are used and are connected to the stud, positively by a flexible connector, thus taking the



DYNAMO.

current over all the joints and springs of the brush holder. Two cables carry the current to a terminal board on the top of the machine whence it is distributed to the field magnets and to the main circuit. The machine is provided with appropriate belt tighteners and aligners, and

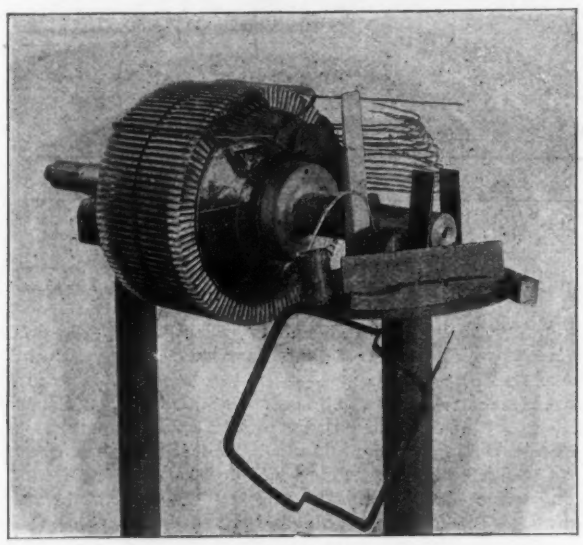
the company feels sufficiently well satisfied with its construction to back it up with the most substantial guarantees.

Besides this dynamo, the Fisher Electrical Manufacturing Company has been producing small switchboards and in this field it has always shown something artistic and attractive. We illustrate herewith a small switchboard made by this company, designed for four circuits and provided with a main switch. The cut will speak for itself in the arrangement of the switchboard. Rheostatic control is provided and all of the circuits are fused, including the main circuit. Ammeter and voltmeter suitably illuminated are also shown. Such a board would be suitable for a small steam yacht or a small private lighting plant, and is not only useful but ornamental on the walls of the engine room.

Eickemeyer Armature Coils.

One of the important economical questions confronting street railway managers is the ease with which repairs may be made to damaged motor armatures. Up to quite recently any repair to the winding of an armature has been a task involving considerable trouble, as well as the enforced idleness of the armature a disproportionate length of time. The advantages therefore of having motor armatures so wound that damaged coils can easily be removed and perfect coils substituted were so patent that the General Electric Company early adopted the Eickemeyer system of winding for the armatures on all its different types of street railway motors.

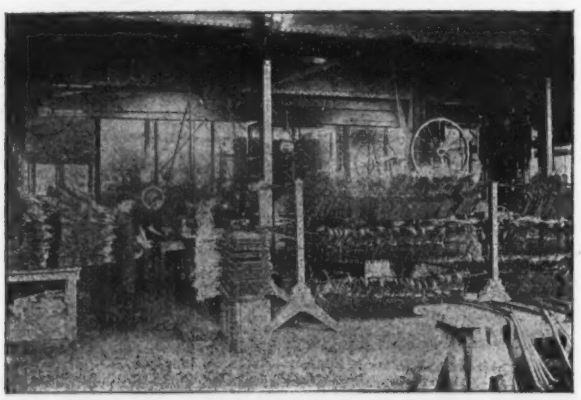
At its works at Schenectady an entire department is given over to the manufacture of these coils, and some idea of the size of this department may be gathered from the fact that its daily capacity is about 7000 completed coils, and it is worked full time. The accompanying illustrations show the different sections of the department and the progress in



Railway Motor Armature. Coils in Place.

the manufacture of the coil from the plain wire through the insulating, taping, dipping and drying sections, from the last of which the finished coil goes to the armature winder.

The manufacture of these coils has formed the subject of constant study and experiment on the part of the railway engineers at Schenectady, with the consequence that a steady improvement has been made in the methods of manufacture and the material used. Patented machinery of



Drying Room.

the latest type and highly skilled help are employed, with the result that perfect accuracy in shape and absolute uniformity in insulation are attained. This serves to eliminate the loose coil subject to abrasion in service, as well as that with thick and uneven insulation, which is easily broken during application to the armature core. The fabrics, oils and japans are carefully selected and are subjected to inspection and test by experts.

In addition to the facility of repair afforded by the Eickemeyer winding, a uniform resistance in the several circuits, great economy in space,

Winding the Coils.

and a more perfect insulation are possible. Over 2,250,000 of these armature coils are now in use on General Electric motors.

An Improved Engine.

A new engine is being put on the market by the Erie City Engine Works, Erie, Pa. It is a decidedly new departure in engine building, and it seems as if there might be a field for this particular type. The peculiarity of the engine lies in the valve gear, being operated by four independent valves. Two of these valves, which control the release and compression, are of the regular Corliss type, with direct crank and connecting-rod motion at the wrist plate. The other two, controlling admission and cut off, are also of the Corliss type, but are multi-ported. In addition they are also driven by direct cranks and links, no detaching valve gear being used. This enables the engine to run at a much higher speed than is permitted in the case of an engine using a detaching valve gear, but at the same time closely approximate to Corliss economy.

The cut-off valves are driven by a separate wrist plate and eccentric controlled by a shaft-governor, while the eccentric driving the release valves is rigid on the shaft, the release and compression being therefore constant.

The engine is made in sizes from 12 x 8 inches to 20 x 30 inches, and the average piston speed is 700 feet. This speed is quite high and is therefore admirably suited for direct connection to some of the smaller sizes of dynamos.

The bed of the engine is a modification of the Tangye type and is very stiff and strong. The stroke of the engine is quite long in comparison with the cylinder diameter. The slides are cast and bored in line with the cylinder, the slides on the crosshead being formed in the arc of a circle. Adequate means are provided for taking up the wear on the crosshead and also for its ample lubrication. The lubrication is for the most part performed by sight-feed oil cups. The bearing surfaces are of babbitt metal and those of the main bearing are ingeniously arranged to tighten by means of screws and wedges.

In Fig. 1 a cut of the main bearing is shown. From this it will be seen that the bearing is in quarters, the diameters passing through opposite joints in the bearing being at 45 degrees with the horizontal.

The inner screws raise the wedges at the extremities of the bearing and force inward the side quarters, and also force downward the upper quarter, thus tightening the bearings on three quarters. The fourth quarter

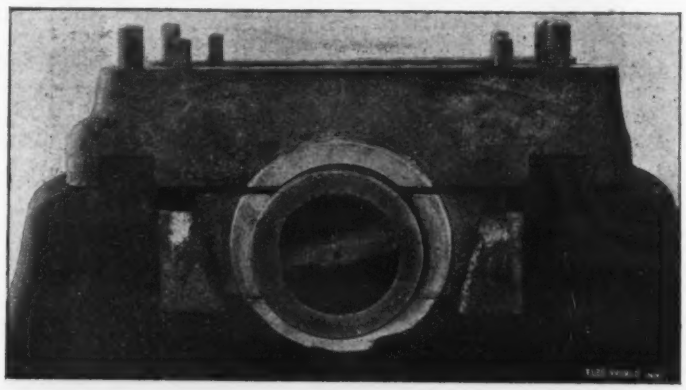


Fig. 1.—Main Bearing.

is tightened by setting up the outer nuts. While this is not an expensive combination it is a very effective one. The valve spindles are made of brass, and the valves of cast iron. The shaft is of liberal dimensions, as are also the steam port openings, of which, as before mentioned, there are several. The cylinder is not steam-jacketed, but is lined with asbestos.

These engines are tested both with brake and indicator before they

leave the shops, and the makers guarantee an economy of 23 pounds of water per hour.

An important feature of this engine is its ability to carry an enormous overload. The mechanism of the governor is such that should the load prove heavy enough to demand it the engine would take steam nearly across the cylinder, like a steam pump. The engine is built sufficiently strong to stand this load. This of course would not be economical, but

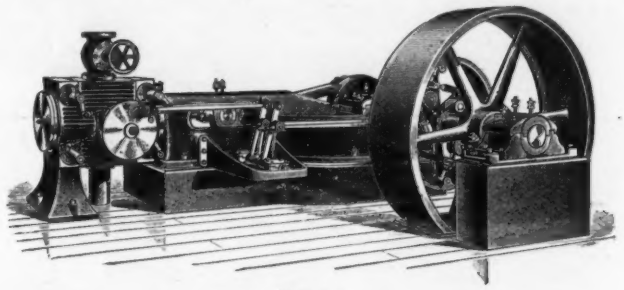


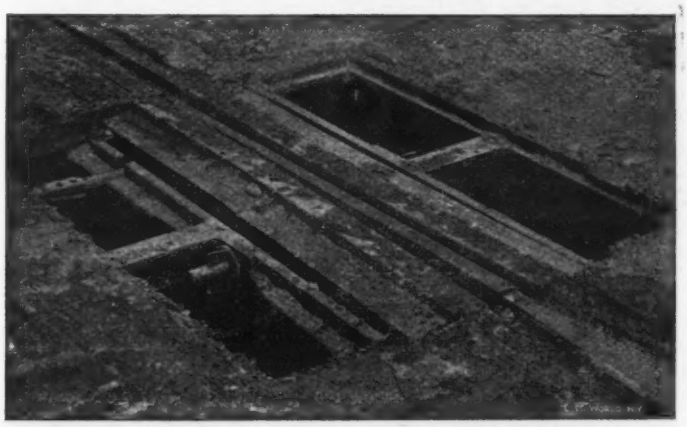
FIG. 2.

times arise when power must be had and economy thrown to the winds. The rating of this engine is therefore limited by the point of economy rather than the point of mechanical capacity. Such an engine is preferable to all others for certain classes of work. Fig. 2 gives a general view of the engine.

A New Railway Switch.

The Cleveland street railway companies seem determined to avoid disastrous accidents such as that which occurred last Winter on the Central Viaduct.

The Cleveland Switch, Frog & Crossing Company has assisted them materially by producing a switch which practically prevents a car from being other than willfully run on a railway track or drawbridge in time of danger. A general view of the switch is seen in the accompanying illustration. It is a derailing switch and normally remains open so that any car if it proceeds without further ceremony would run off the track. In order that the car may proceed, the conductor must leave the car some 20 feet on one side of the crossing, cross the tracks and pull up a lever on the other side, and hold the same in position, when he may then signal the car to go over. The switch is operated by wires, chains and levers through underground tubes, but in some cases the wires pass upward through a steel pole, and by bell-crank levers the motion is transmitted horizontally across the track by a suspended wire and down another steel pole to the switch. It seems next to impossible for an accident to occur with such an arrangement, since the conductor must himself occupy the dangerous position before he can place others in it,



IMPROVED ELECTRIC RAILWAY SWITCH.

and he must deliberately, in full sight of the danger, stand at his post and hold the switch in position for the car to proceed to its own destruction. No amount of absent-mindedness or anything but criminal intent could ever cause an accident under these conditions.

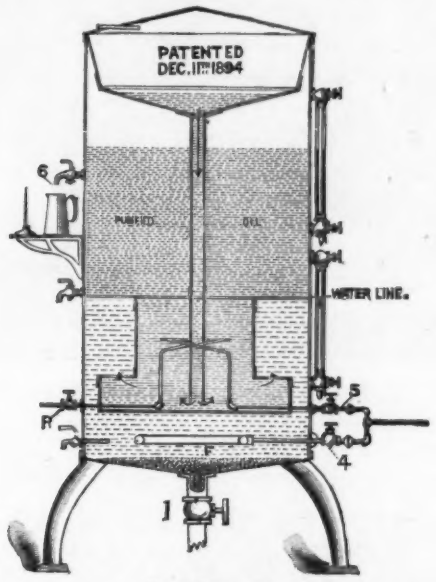
Oil Purifier.

For the past 10 years various methods and devices have been used to filter and purify waste machine and lubricating oils, after they have done their work and have become dirty and unfit for use. A number of filters which passed the dirty oil through cotton waste, felt, sawdust, etc., have become disfavored, it being found that the larger particles of oil and the paraffin wax which give body and viscosity to the coil is filtered out with the impurities, and the product is a light rarefied oil, injurious to machinery, rather than a purified oil fit to be used again.

The oil purifier of the McClelland Oil Purifier Company, 66 Broadway, New York, employs as purifying agents only heat and water. It is constructed on strictly scientific principles, the purification being mechanical and automatic, requiring no skill or attention.

Referring to the accompanying diagram, of the purifier connection should be made at valve 1 with the sewer; and at 4 and 5 with the exhaust steam. The purifier is filled one third with water, and is gently warmed by turning on the steam at 5. The impure oil is thrown into the top chamber *A*, and passing by gravity through a strainer *B*, very gradually finds its way into and down the vertical pipe *C*, in the centre of the tank, mixing with the water *D* in the bottom.

An inverted bell prevents the dirty oil in *D* from rising to the top of



OIL PURIFIER.

the water, while the heat from the steam coil forms fine oil globules from the mass which gently rise as cream rises on milk—the sediment, grit, dirt and all impurities heavier than the water being readily precipitated, dropping to the bottom.

From this chamber *D* the oil passes out at the bottom and through outlets, as shown by the two small arrows, into chamber *E*, where it is washed by passing through the water. Around the outside and flush with the top of the bell is a wire gauze screen which prevents such impurities of the same specific gravity as the oil from rising with it into the storage reservoir above, marked "Purified Oil."

A great advantage of this purifier is the facility with which it can be cleansed.

As the company guarantees that all the dirty oil placed in the purifier will be made as good as the original oil, the saving depends entirely upon the amount of oil that can be caught in the drip pans, which ought to be at least 75 per cent., and some times as high as 90 per cent.

This purifier is made in six sizes, and large quantities of oil can as well be purified as a few gallons. They are made of heavy galvanized iron with brass fittings and handsomely painted, and are an ornament to any engine room.

The Straight Line Engine and How It Is Made.

The Straight Line Engine Works in Syracuse, N. Y., are well equipped with modern machine tools for the building of their engine. From the accompanying interior view (Fig. 1) it will be seen that cranes for handling the heavy parts are provided.

The Straight Line engine takes its name from the distribution of metal between the cylinder and the main bearings. It is argued that the stresses are chiefly between the cylinder and the main shaft, and that therefore the metal should be placed in line so as to do the most good.

The engines designed for electrical work are rated in kilowatts, which is an excellent method to pursue.

The cylinders of the company's recent designs are bushed so that the same kilowatt engine may have the size cylinder best suited to the steam pressure. Hard iron may be used for the bush and a worn out bush replaced.

The piston is made hollow by putting together the open ends of two cups, and in the bottom, or what forms the ends of the piston, is forced in two or more tapering plugs, and of such taper and put in with such force as to require a pressure twice as great as the steam pressure to knock them out, or what is in fact knocking them into the piston, so that if water is caught in the cylinder one or more of these plugs is driven in and the clearance of the engine increased in amount equal to the capacity of the piston. Whenever these plugs are driven in they are caught on a pin and prevented from rattling about, and a hole drilled from the inside of the piston to the outer end of the piston-rod permits a little steam to blow out, thus giving notice to the engineer that the relief or "pop plugs" have been driven in and an accident averted.

The valve is a double-ported balanced one, controlled by a single ball shaft governor. The piston rod packing is a simple babbitt metal sleeve, held between two ball and socket washers as shown in Fig. 2. Tightening up is entirely unnecessary, the steam leak being prevented by the

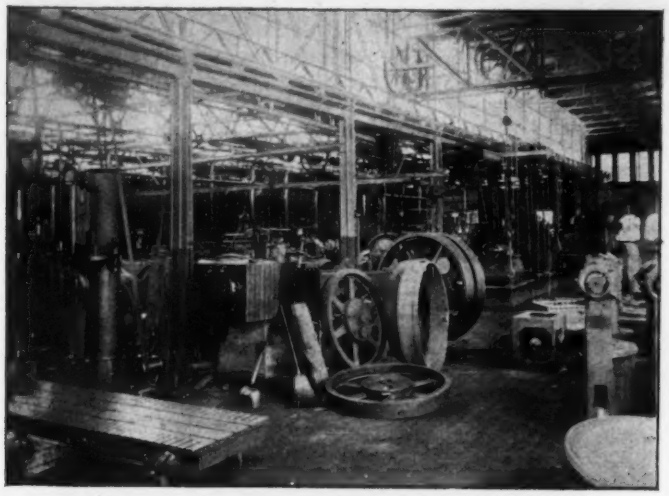


Fig. 1.—Interior View Straight Line Engine Works.

mechanical fit. The crosshead is a steel casting with a cast iron bottom, and the rod is threaded in a split nut. The guide for the crosshead is a loose casting adjustable on inclined planes and is confined in a basin cast

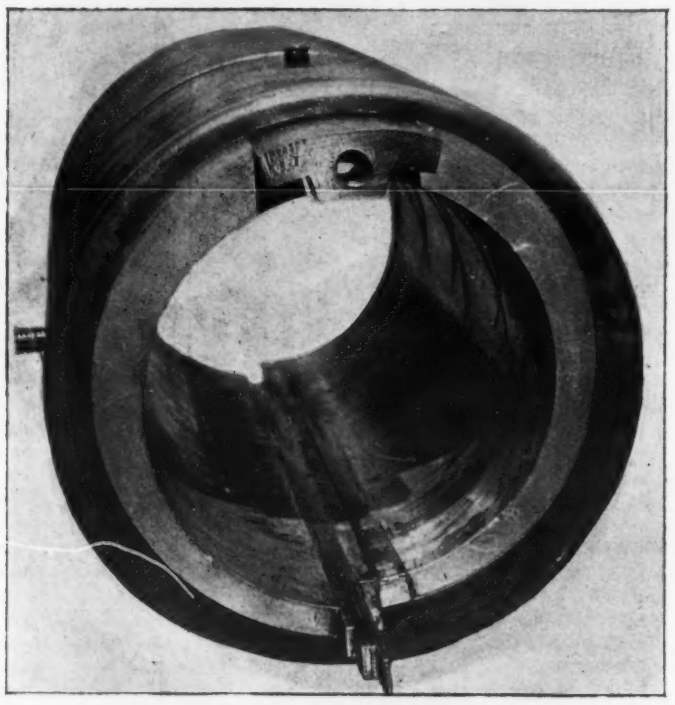


Fig. 2.—Main Bearing.

in between the two arms of the frame. The connecting rod is made fast to the crosshead pin by a grip fit and the pin turns in two bearings, the wear being compensated for by two wedges tightened by a single bolt. The crank is of the double disc sort, the discs forming the bosses of the two fly-wheels, and oil from the drip of one of the boxes is thrown by

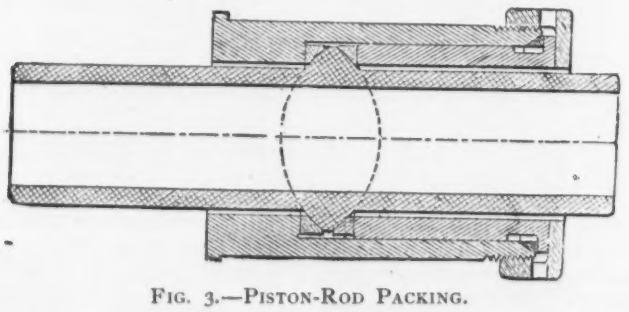


Fig. 3.—Piston-Rod Packing.

centrifugal force to the crank and from the other box to the eccentric. The governor, which is mounted on the wheel on the steam chest side of the engine, consists of a single ball which balances the eccentric, and its attachments control the speed by shifting and changing the throw of the eccentric. The speed of the engine is varied by shot in the governor-ball or changing leaves in the spring.

One of the main boxes is shown in Fig. 3. It is the original ring oiler which is now largely used in dynamo practice. The box consists of an eccentric sleeve lined with eccentric babbitt cheek pieces, so placed that the bearing is concentric with the outer surface of the shell. The cheek pieces are held by a wedge at top and supplied with a number of thin liners at the bottom. By changing the liners from the bottom to the top the wear is taken up.

The reciprocating parts of the engine are fully balanced, thus insuring running without end shake.

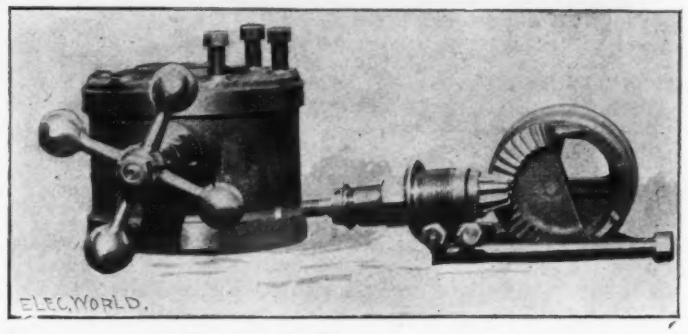


Fig. 4.—Throttle Complete, and Parts of Same.

The spindle of the throttle carries a bevel pinion which meshes in a bevel gear cut in a circular plate. In the latter is a semi-circular hole. This plate rests upon the top of a cylindrical pillar of the same diameter, which forms the valve seat. The semi-circular hole in this seat is of the same size as that in the disc, and allows the steam to pass when these two holes are coincident.

When the holes are moved by the spindle and bevel gears so that they are no longer in line the valve is tightly shut by the steam pressure. The shell of the throttle is secured to the top of the cylinder by long bolts, as shown in Fig. 4, and the valve pillar, slightly tapered, is driven in the bottom of the shell. In Fig. 4 the complete throttle and accompanying parts may be seen.

The Straight Line engine is tested by the brake and indicator method, as shown in Fig. 5. The power is weighed at the brake by an ordinary

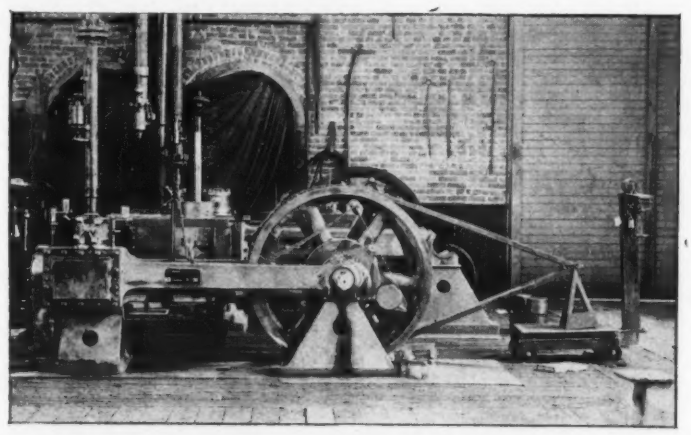


Fig. 5.—Testing Engine.

platform scale and indicated at the cylinders by a pair of Crosby indicators.

The tandem compound engine, which Prof. Sweet is now building, and which is shown in Fig. 6, is notable for the unique arrangement of its

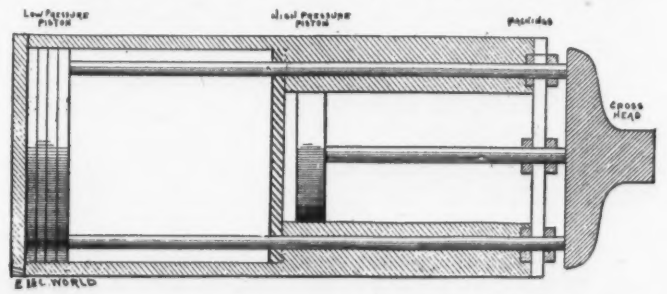


Fig. 6.—Piston Arrangement of Tandem-Compound Engine.

pistons. The low-pressure piston, it will be seen, has two rods, the packings of which are easy of access. The necessity of a yoke between the cylinders is done away with and the combined cylinders are much shorter than usual types.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Aug. 20, 1896.

ELECTRICAL STOCKS.—The general market was about steady, no marked changes one way or the other being noted, excepting General Electric preferred, which is quoted in Boston at a much lower figure than previous quotations. There was an extremely small trading in the common stock, only 300 shares having changed hands during the week. The closing price shows a loss of ⅛. Westinghouse is about steady as to price, both for common and preferred.

TELEGRAPH AND TELEPHONES.—Bell stock shows a drop of 1 per cent. on the week's business, while New England is about steady. Erie telephone advanced one point. The sales of Western Union stock during the week were 9282, and the tone of trading was somewhat better, prices advancing one point as compared with last week's quotations. Postal telegraph is quoted at a point lower than last week's closing.

TRACTIONS.—Street railway securities were very quiet during the past week, although there was a better inquiry for a few stocks. The only advances noted—and they are merely fractional—are Buffalo Street Railway and West End common. The losses are more numerous, but they, too, are fractional.

EARNINGS.—The New Orleans Traction Railway reports gross earnings for July of $116,106, a decrease of $3,982 as compared with the same month of last year, and net $41,474, an increase of $849.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	..	..
Edison Electric Ill., New York	100	90	93
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	23½	24½
Electric Storage, pref	100	25	26
General Electric	100	23¾	24
General Electric, pref	100	55	60
Westinghouse Consolidated, com	50	23	25
" " pref	50	48	49

BONDS.

Edison Electric Ill., New York	105	107½	108
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	85	..

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	197	199
American District Telegraph	100	*29	39
American Telegraph & Cable	100	..	89
Central & South American Telegraph	100	124	127
Commercial Cables	100	125	..
Erie Telephone	100	56	57
New England Telephone	100	91	92
Postal Telegraph-Cable	100	72	76
Western Union Telegraph	100	76⅞	77

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	15⅛	15½
Brooklyn Rapid Transit		19½	20¼
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	59	61
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	38	40
Hestonville	100	45	46
" pref		..	62½
New Orleans Traction	100	8	10
" " pref	100	..	60
North Shore Traction	100	18	20
" " pref	100	68	72
Rochester St. Ry	..	15	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	105
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	65	..
" " pref	100	85½	..
Worcester Traction	100	13	15
" " pref	100	83	85

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	72½	..
Buffalo St. Ry. 1st con. 5s	100	101	*104
Cleveland Elec. Ry. 1st mtge 5s	100	100	*104
*Columbus St. Ry. 1st 5s	100	90	*95
Rochester St. Ry. 1st 5s	100	95	100
Union Railway (Huckleberry) 1st mtge 5s		100	*104
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, August 31, 1896.

MR. CHAS. E. BIBBER, of the Crefeld Electrical Works, Boston, was in the city last week.

F. M. LOCKE, of Victor, N. Y., visited New York last week, and reports good prospects for Fall business. He has made some recent improvements in his well-known line of insulators and insulator pins, which will undoubtedly increase their well-deserved popularity in the field.

MR. A. J. DOWLING, who has recently accepted a position with the Garvin Machine Company, as advertising manager, has had considerable experience in newspaper work as advertising solicitor, publisher, and proprietor, thus acquiring a very thorough knowledge of the work required of him in his new position.

MANUAL OF TELEGRAPHY.—The E. S. Greeley & Co., 5 and 7 Dey Street, have just issued a new edition of Smith's *Manual of Telegraphy*, which has been the standard work of its kind for years. Some valuable matter has been added which brings this pamphlet up to date. Many telegraphers received their rudimentary instruction in telegraphy from Smith's Manual.

A. L. BOGART.—We are requested to announce that on Aug. 19, Mr. Eugene L. Bogart purchased the business of his father, A. L. Bogart, recently deceased, and will carry it on at the same address and under the old name, by which it has been known for so many years. Mr. Bogart's long connection with the business, during which he has acquired a wide experience and acquaintance in the trade, will insure its continuance on the old lines, upon which the reputation of the house were built. We bespeak for Mr. Bogart the continuance of the good will of the trade.

MR. JOHN JORDAN, of Schiff, Jordan & Co., carbon manufacturers, Vienna, Austria, is in the city. Mr. Jordan has opened an office at 39 Cortlandt Street, and placed it in charge of Mr. R. Straschenow, a member of the above-named firm. Mr. L. E. Frorup has been appointed general sales agent of the same company. New carbons for alternating and direct-current recently brought over by Mr. Jordan have been tested and tried by some of the large stations in this vicinity. They are said to have proved highly satisfactory, giving a steady light, with long life and freedom from dirt.

STORAGE BATTERY PLANT FOR GOV. MORTON.—The Electric Storage Battery Company has closed a contract, through Messrs. W. T. Hiscox & Co. for a storage battery installation for "Ellerslie," the residence of Gov. Morton, at Rhinecliff, N. Y. The battery, which will be located in the power-house, 1400 feet away from the mansion, will consist of 67 chloride accumulator elements, type G-11, in lead-lined wooden tanks. The generator will be run but a few hours per day, and the battery will carry the lighting load during the time that the dynamo is shut down, and over Sunday, thus giving a 24-hour lighting service per day with but a comparatively very few hours' run of the generator.

SUPERINTENDENTS OF FIRE AND POLICE TELEGRAPHS.—On Aug. 22 a meeting of municipal police and fire telegraph superintendents was held at the Municipal Building, Brooklyn, for the purpose of taking steps toward forming an organization of these officials of the various cities in the United States. A resolution was adopted to the effect that owing to the lateness of the season the formation of the organization at this time was deemed inexpedient, and that further action in the matter be deferred indefinitely. The Committee of Arrangements adjourned subject to the call of the chairman, Mr. M. R. Brewer, superintendent of police telegraph, New York City. Among those present, besides Mr. Brewer, were Mr. F. C. Mason, superintendent of police and fire telegraph, Brooklyn, N. Y., and Mr. W. H. Foley, superintendent of police telegraph, Jersey City, N. J.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, Pa., Aug. 28, 1896.

NEW TELEPHONE EXCHANGES.—Arrangements are being made for the erection of four new telephone exchanges in this city, which improvements are rendered necessary by the growth of business.

MR. S. W. ENTREKIN has sold out to Mr. Elder his interest in the Entrekin-Elder Electric Company, of Philadelphia, Pa., and has purchased the business of Freese Bros. & Co., electrical contractors, and will continue the business under the new title of the Entrekin Electric Company.

I-T-E CIRCUIT-BREAKERS.—The Cutter Electrical & Manufacturing Company, Philadelphia, reports that sales during July and August exceeded business done in any previous two months in the history of the company. This is largely due to the success which has attended its efforts to introduce its I-T-E circuit-breaker. The company has closed contracts for I-T-E circuit-breakers with some of the most exacting electrical concerns in the United States. These

orders, it is stated, were not placed until the circuit-breakers were subjected to every known test and it was clearly demonstrated that the device would do all and more than was claimed for it. A new edition of the I-T-E circuit-breaker catalogue is ready for the press. This catalogue will be made of a size to fit the pocket. It will be ready about Sept. 20, and will be sent on application.

Western Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
Chicago, Ill., Aug. 27, 1896.

REMOVAL.—J. Holt Gates has removed his office from 311 Dearborn Street to Suite 1143 Marquette Building, where the agencies of the Walker Company and the C. & C. Electric Company will henceforth be located.

ASSIGNED.—The Dearborn Electric Company, Chicago, made an asssignment a few days ago to Warren D. Drake. The company carried on a business as dealers in electrical supplies at 19 Quincy Street. Its assets are placed at $4,500, and liabilities $5,000.

A. L. IDE & SONS will be the new name of the Springfield, Ill., steam engine building firm hitherto known as A. L. Ide & Son, the change being made by the addition of a new member, Mr. Roy W. Ide. The firm will hereafter consist of Messrs. Albert L. Ide, Harry L. Ide and Roy W. Ide.

THE ELECTRIC APPLIANCE COMPANY has been particularly successful during the past month in closing some large deals for "O. K." weatherproof wire. Several orders for good-sized complete new plants have been booked, together with some large orders for extensions for already existing plants.

BUSINESS EMBARRASSED.—The E. & C. Electric Company of Cleveland, O., confessed judgment in favor of James A. Crawford in a suit for $20,658 with interest at 6 per cent. The suit was brought on promissory notes. It is expected that arrangements can be made so that the business of the company can be continued.

THE INDIANAPOLIS ELECTRIC COMPANY.—All rights, titles and interests of S. V. Smith in the Indianapolis Electric Company were, on Aug. 20, 1896, bought by John H. Murphy. The business of the Indianapolis Electric Company will be carried on under the same firm name by John W. and John H. Murphy. Mr. H. V. Smith has now no connection whatever with the concern. All bills and accounts will be received and paid by the Messrs. Murphy.

REMOVAL.—The Emerson Electric Manufacturing Company, St. Louis, Mo., will in a few days move its offices and factory from its present location, 1108-1112 St. Charles Street, to the corner of Eighth and St. Charles Streets. The new quarters will occupy an entire floor of the building, which covers a quarter of a block and is well adapted for the Emerson Company's business. The floor space will be large, which will enable the company to better handle its increasing business. The entire manufacturing work, from beginning to end, will in the new quarters be under the direct supervision of the managing force. Improvements will be added to the plant, and its capacity will be largely increased, which facilities will enable the company to produce the best quality of goods and work for the lowest price. The company has several new specialties in process of development.

Canadian Notes.

Montreal, Can., Aug. 27, 1896.

ST. THOMAS, ONT.—The City Council will submit a by-law to the ratepayers for the establishment of a city electric light plant.

HAMILTON, ONT.—The shareholders of the Hamilton & Dundas Railway have approved of the conversion of the road into an electric line.

HUNTSVILLE, ONT.—Mr. Vaughan M. Roberts, C. E., of St. Catharines, has prepared plans and specifications for an electric light plant, and the work will shortly be advertised.

PORT ARTHUR, ONT.—The Port Arthur Pulp Timber Company is being incorporated to manufacture timber and to construct electric light and power works. The capital stock is $200,000.

MONTREAL, QUE.—The Montreal Park & Railway Company proposes erecting two new power-houses, one at Lachine and the other at St. Laurent. The plans are now in course of preparation.

THOROLD, ONT.—The company that intends building an electric railway between Hamilton and Niagara Falls will build a power-house on the site of the Morning Star grist mill at Decrew's Falls.

QUEBEC, QUE.—The engineers for the proposed electric railway are said to have made arrangements for the commencement of the work in September. Some of the supplies have already been ordered.

PETERBOROUGH, ONT.—The Auburn Light & Power Company has been organized here. The promoters are: Messrs. James Kendry, M. P., John Carnegie and W. H. Meldrum. The company will supply light and power.

HAMILTON, ONT.—Mr. F. G. Beckett, the promoter of the Hamilton, Chedoke & Ancaster Electric Railway, is said to have secured the necessary right of way, and steps will be taken at once to complete the organization of the company.

COBURG, ONT.—The Canadian Electric Railway & Power Company seeks power to build an electric railway from Coburg *via* Port Hope, Bowmanville, Oshawa, Whitby, Toronto, Oakville and Hamilton to Suspension Bridge and Niagara Falls.

THREE RIVERS, QUE.—The city has sold its electric light plant to Messrs. Fregeau and Lacroix. Their backer, it is believed, is a New Yorker. The new company will get its power from the Batiscan River from falls at Price's Mills. The current will therefore have to be transmitted 14 miles to the city. It is also proposed to supply neighboring villages.

MONTREAL, QUE.—The new chimney in connection with the extension of the boiler house of the Montreal Street Railway Company is nearing completion. This chimney, which will be 255 feet high, is claimed to be not only the largest, but also the most model structure of its kind in Canada. It has a base of 54 feet square, and before the top is reached over 2,000,000 bricks will have been brought into requisition. It is expected, with fine weather to have this mammoth chimney completed within a fortnight. The whole of the work has been superintended by the Construction Department of the Montreal Street Railway.

English Notes.

(From Our Own Correspondent.)

London, Aug. 19, 1896.

THE SUBMARINE TELEGRAPH MEMORIAL.—Considerable progress is being made in this country in forming a strong and representative committee in connection with the proposal to erect a memorial to commemorate the inception and extension of submarine telegraphy. Among those who have agreed to act on the committee are Lord Kelvin, the Lord Chief Justice; Mr. Joseph Chamberlain, Secretary for the Colonies; Sir Richard Webster, Sir Samuel Canning, Mr. W. H. Preece, Dr. John Hopkinson, Mr. Alexander Siemens and Dr. Alexander Muirhead. An opportune moment for inaugurating this memorial will be next year, when it is proposed to celebrate in a fitting manner the 60th year of the Queen's reign, which has been exactly coincident with the introduction and extension of telegraphy.

COMBINED ELECTRIC LIGHTING AND TRACTION PLANTS.—A movement in favor of combining the electric traction and electric lighting business is growing apace in this country. Last week the Plymouth Town Council adopted, almost without dissent, the report of their borough electrical engineer, Mr. J. H. Rider, recommending a municipal electric lighting station on the alternate-current system, with distribution on the three-wire system from sub-stations, arrangements to be made to supply the municipal railways with electrical energy at the inclusive price of 3½d. per kilowatt-hour. Another point in the borough electrical engineer's report is the recommendation that the cables throughout should be of the triple concentric, lead-covered, steel-armored type laid direct in the ground. This is a type which is growing rapidly in favor in this country. A third point was the engineer's recommendation that the public arc lighting should be carried out by means of rectifiers. This is yet a third practice which is likely to become prevalent in this country. It is perhaps needless to add that the heating of a portion of the boilers is to be carried out by the waste heat from the refuse destructor.

ELECTRIC TRACTION AND MUNICIPAL PURCHASE.—At a recent meeting of the Bristol Tramways Company the chairman, in his remarks to the shareholders, brought out very clearly the danger of the immediate and general adoption of electric traction in this country. He pointed out that if they were to extend electric traction to the whole of their system, it would practically mean the doubling of their capital expenditure, and this, of course, he could not recommend the shareholders to do unless the Corporation of Bristol were prepared to grant the company a considerable extension of its lease, or were prepared to allow it to make greater profits than it was at present making, the extra profits being devoted to extinguishing the original capital lost in equipping the Bristol system on the horse-traction principle. Although the Bristol Municipality seems to be wide awake to the desirability of securing electric traction for their city, they do not seem to see that they cannot expect a company to equip a large number of miles of railways merely to please the good people of Bristol and without any hope of extra profits or of making good the loss incurred in the early days of the railway enterprise.

ELECTRIC TRACTION IN CAPE COLONY.—At the beginning of the year the Government at the Cape of Good Hope, being somewhat pressed in all directions to grant concessions for electric railways, etc., decided to obtain the permanent services of an expert, and in due course a Cape electrician and inspector was appointed. From a recent report of this gentleman on a scheme for providing the subways of Cape Town with a system of electric traction it is evident that the trolley, in its undiluted form, will not be permitted. The disadvantages of the plain trolley system are summed up as follows: (1) The trolley wire is a nuisance. (2) Serious dangers may result if it breaks. (3) Span wires are an inconvenience and are ugly. (4) The overhead insulator switches and frogs are extremely ugly, and the leakage current is liable to corrode. (5) Gas and water pipes disturb the telegraph and telephone service and derange railway signals. After this indictment it is satisfactory to find that the side trolley system, or the direct trolley system, is reported on in a more or less favorable manner. With regard to the question of safety, the adviser to the Cape Government makes the following remark: "After 109 fatal accidents on the electric railways in Brooklyn alone, and when fatal accidents had been occurring more than once a day, the city authorities proceeded against the president of the largest company for manslaughter in 1895. The speed of the cars was then reduced to well below eight miles an hour, and the public repeatedly complained of the inconvenience of the slow speed. It was asserted that the public must have rapid transit, and that the many deaths resulting from this necessity were an unavoidable sacrifice to the exigencies of modern progress." It is evident from this paragraph that in the matter of speed something very different from the practice in the United States will have to be adhered to in Cape Colony.

THE MUNICIPALITY OF GLASGOW AND ELECTRIC TRACTION.—A few years ago, just previous to the taking over of the railway system of Glasgow by the municipality, a committee of the Town Council solemnly gave a decision adverse to mechanical traction. No sooner, however, had the railways come into the possession of the corporation than the question of mechanical traction was again discussed. Finally a committee was appointed to consider the matter, and the deliberations of this committee soon became a mere weighing of the advantages and disadvantages of various forms of *electric* traction. Ultimately a sub-committee was appointed which traveled all over the Continent, viewing the various cities in Germany and France and collecting information which has recently been embodied in an elaborate report. The concrete result of all this labor was the recommendation of the

Railways Committee that electric traction on the overhead trolley system should be adopted on one of the Glasgow lines and that immediately. A few days ago this recommendation was discussed at great length by the Glasgow Town Council, and finally the question was again remitted to the committee. There was an almost unanimous expression of opinion in favor of electric traction, but there was an almost equally unanimous expression of opinion that the time was not yet ripe for the adoption of electric traction, even tentatively. It was said that the public had not yet made an outcry for electric traction, and until they did so they would not be justified in risking the ratepayers' money in a new departure. This is a tolerably fair argument, but I must say that the argument of one of the Town Councilors that the best way to open the eyes of the Glasgow public to the disadvantages of horse traction would be to equip a portion of the line with electric traction and make it a success is a better one. This view, however, did not commend itself to the Glasgow Town Councilors as a whole.

MUNICIPAL ENGINEERS AND ELECTRIC LIGHTING COMMITTEES.—Municipal engineers in this country have a good deal to contend with. At the outset they are liable to be placed under the not too favorable supervision of the Borough gas engineer, and have to work a system laid down upon the advice of an outside expert without sufficient knowledge of the particular wants of the locality; then when the time comes for extensions, they have to fight hard if they wish to secure the arranging of these extensions themselves, and fight harder still to secure permission to carry them out. Electric lighting committees and town councils never seem quite happy unless they are mangling and objecting to the schemes submitted to them. Quite recently in a seaport in the North of England the engineer endeavored to secure permission to erect a second station on the outskirts of the town with a view to reaching the residential districts of the town and thus obtaining an improved load factor, and with a view of providing betimes for the natural growth of the demand. He was so far successful as to obtain the consent of his committee, but when the committee endeavored to obtain the consent of the Town Council it found a formidable opponent in an ex-chairman of the Electric Lighting Committee, who succeeded in obtaining a rejection of the scheme on the following cogent grounds: A scheme, he said, in which the cables were not laid in culverts condemned itself. No extensions ought to be undertaken without the advice of an "outside expert." Any electrician worth his salt knew that an electric lighting station should be as near as possible to the centre of the area of supply. High pressure was too dangerous to be used. Possibly these remarks were prompted partly by pique, and if so, the episode is a striking confirmation of the remark made by a well-known engineer employed by a company, who, when asked to become a municipal engineer to an important town, said that he had no liking for the job since municipal electrical work was diplomacy and not engineering, and he was no diplomat.

General News.

New Incorporations.

THE NEW LONDON ELECTRIC LIGHT COMPANY, New London, Wis., has been organized by J. L. Halle, J. M. Hellef and Bessie C. Hellef.

THE CAMMETT MINING & ELECTRIC AMALGAMATOR COMPANY, Denver, Col., has been formed by Ira A. Cammett, C. W. Angle and Henry Michaelson. Capital stock, $100,000.

THE FERNDALE ELECTRIC COMPANY, Ferndale, Cal., capital stock, $10,000, has been formed by W. D. Capwell, J. A. Shaw, C. H. Boynton, W. S. Wright and C. T. Schreiner, Ferndale, Cal.

THE START ELECTRIC LAMP COMPANY, Turners, N. Y., has been formed, with a capital stock of $50,000, by John Silver, New York; Richard R. Moffatt, Brooklyn, and George W. Mills, Elizabeth, N. J.

THE GLEN ELLYN & LOMBARD ELECTRIC LIGHT & POWER COMPANY, Glen Ellyn, Ill., has been incorporated with a capital stock of $20,000. Those interested are: Thomas Gibson, Joseph J. Gibson and Charles F. McElroy.

THE BALDWINSVILLE HEAT & LIGHT COMPANY, Baldwinsville, N. Y., has been incorporated by William F. Morris, James W. Upson, Baldwinsville; Bartlett Smith, Syracuse, and John W. Stearns, Akron. Capital stock, $20,000.

THE DALE COMPANY, New York, N. Y., has been incorporated to manufacture electric light chandeliers, electrical supplies, etc. The incorporators are William E. Hawkins, John H. Dale and Dorothy Dale. Capital stock, $25,000.

THE CALCIUM CARBIDE COMPANY, New York, N. Y., has been formed with a capital stock of $1,200,000. Those interested are Emerson McMillin, Spencer D. Schuyler, Francis Wyatt, Dewitt C. Flanagan and Richard W. Rundle, New York.

THE BRADLEY ELECTRIC LIGHT, HEATING & POWER COMPANY, Cleveland, O., has been incorporated with a capital stock of $100,000. The incorporators are George Lillis, John C. Burgess, S. H. Holding, M. W. Neal and Frank S. Master.

THE AMERICAN STORAGE BATTERY COMPANY, San Francisco, Cal., has been formed with a capital stock of $25,000. Those interested are W. T. Bell, T. Z. Hardee, E. M. Massey, B. H. Bancroft, San Francisco, and C. S. Prebbe, Berkley, Cal.

THE MEDWAY & FRANKLIN STREET RAILWAY COMPANY, Medway, Mass., has been organized with a capital stock of $40,000, for the purpose of building a line 16 miles long, running from North Bellingham through Caryville, West Medway, Medway and Franklin to Wrentham.

THE MONTCALM COUNTY TELEPHONE ASSOCIATION, Stanton, Mich., has been organized by C. W. French, J. N. Crusoe, P. J. Devine, T. S. Earle, all of Stanton; B. S. Swarthout, A. Entrican, Robert Evans, C. G. Mason, J. S. Dennis, B. Hayes and J. E. Just. Capital stock, $5000.

THE LACOCK STREET RAILWAY COMPANY, Pittsburg, Pa., has been incorporated for the purpose of building an electric street railway in Allegheny City on Lacock Street. The promoters are Joshua Rhodes, Allegheny; M. W. Brannen, Pittsburg, and James A. McDevitt, Lancaster. Capital stock, $12,000.

THE LONG-DISTANCE ELECTRIC TYPOGRAPH COMPANY, St. Louis, Mo., capital stock, $100,000, has been organized for the purpose of manufacturing and selling mechanical machines and instruments. Those interested are Joseph J. Roifgraber, Jacob Handelman and C. P. Connolly.

THE KERR STREET RAILWAY COMPANY, Pittsburg, Pa., has been organized for the purpose of building a street railway in Allegheny City, in Kerr Street, to be operated by compressed air or electricity. Those interested are James R. Jenkins, Allegheny; Oscar R. Gratty, Crafton, and M. J. McCann, Pittsburg, Pa. Capital stock, $6000.

THE NATIONAL SHIP COPPER-PLATING COMPANY, New York, N. Y., has been incorporated in West Virginia, for the purpose of plating or coating with copper, iron or steel the hulls of vessels by an electrical process. The incorporators are C. Alex. Hamilton and George Wm. Ballon, New York, and Samuel F. Adoms, Brooklyn. Capital stock, minimum, $250, maximum, $1,500,000.

Telegraph and Telephone.

RACINE, WIS.—The Northwestern Telephone Company has formally accepted the franchise recently granted and will begin active operations at once.

KEOKUK, IA.—Franchises have been granted to the Kahoka Telephone Construction Company and the Western Illinois Telephone Company to operate exchanges in this city.

BOSTON, MASS.—On Oct. 1 next the New England Telephone Company will open an exchange in South Boston. South Boston business is at present conducted from the Boston and Tremont exchanges.

CHATTANOOGA, TENN.—The Chattanooga Telephone Company has been granted a charter. Col. J. C. Duncan, of Knoxville, is at the head of the company, and will begin putting in the exchange as soon as possible.

CICERO, ILL.—A new telephone company has been chartered in this place with a capital stock of $20,000. Instruments will be put in private residences for $18 a year and it is stated that the company has assurance of 200 subscribers to start with.

CLINTON, MO.—The City Council has granted a 10-year franchise to the Munsell Telephone Company. The company will pay to the city 2 per cent. of its gross receipts. It now operates toll lines to over 30 different towns in Southwest Missouri.

ADRIAN, MICH.—Several gentlemen are interested in the proposed establishment of an independent telephone exchange in this place, and if 200 subscribers can be secured the project will be carried forward. Among those interested are Senator J. C. Rorick, James S. Brailey and A. B Conklin, of Wauseon, O.

THE BELL TELEPHONE COMPANY'S instrument statement for the month ended Aug. 20 shows a net output of 1825, which is 454 less than the net output during the same period in 1895. Since Dec. 20 last the output was 74,836. The total number of instruments outstanding on Aug. 20 was 751,372, which represents an increase of 114,812 over the number outstanding at the same time in 1895.

GREATFALLS, MONT.—H. L. Lane, Sam Stephenson and H. M. Gibbes, of Great Falls, incorporated the North Montana Telephone Company, with a capital of $10,000. It is said that the terminal of the line will be at Great Falls, where the company will have its principal offices, and at Choteau and Augusta. It is proposed to divide the line at Sun River and extend it to Cascade. A branch line may also be built to Dupuyer and the Blackfoot Agency.

Electric Light and Power.

CANISTEO, N. Y.—The subject of an electric light plant in this place is being agitated.

PIEDMONT, WEST VA.—The Council is investigating the cost of putting in an electric plant.

MONTICELLO, ILL.—Monticello is contemplating an electric light plant for street or private purposes.

HARTLAND, WIS.—Hartland people are considering the project of establishing an electric light plant.

MADISON, S. D.—The electric plant at Madison was destroyed by fire, entailing a loss of $3800 with no insurance.

FRANKFORT, KY.—The Sinking Fund Commissioners have decided to put in an electric plant in the State Penitentiary.

ELKHART, IND.—An electric plant is in contemplation for the Driving Park. S. E. Barney can give further particulars.

NEW SHARON, IA.—The electric light plant in this place was entirely destroyed by fire recently, the loss amounting to $8000, with no insurance.

ELKHART, IND.—Carroll Collins, of Chicago, has purchased the Home Electric Light and Power Co. Extensive improvements will be made on the plant.

WHITINSVILLE, MASS.—The Whitin Machine Company has begun the erection of a large electric light station in the west end of the machine shop yards.

OCONTO, WIS.—The City Council of Oconto decided at its last meeting to advertise for bids for lighting the city with arc lights. Incandescent lighting is now used.

MOHAWK, N. Y.—Sealed proposals for building an electric light plant will be received by the Board of Water and Light Commissioners up to 12 o'clock, noon, Sept. 10.

PORT JEFFERSON, L. I., N. Y.—There is a movement on foot here to have a district established and the streets therein lighted by electricity. Supervisor Ritch is interested.

RICHMOND, IND.—A recent flood in this place almost ruined the electric light plant. Every dynamo was entirely covered with water and the city was in darkness until repairs could be effected.

OIL CITY, PA.—It is reported that a receiver has been appointed for the Oil City Electric Company in compliance with the petition of the Western Electric Company in its suit against the Oil City Electric Company and H. H. Stephenson, trustee.

BAMBERG, S. C.—An election was held, and it was decided to bond the town for an electric light plant. H. J. Braham, J. H. Cope and J. D Copeland are the commissioners. It is proposed to light the streets with 30 arc lights and furnish 500 incandescent lights for private purposes.

BROOKLYN, N. Y.—Application has been made in the Supreme Court for a writ of mandamus to compel the trustees of the village of Jamaica to revoke and cancel the resolution passed on July 13, awarding a contract to the Jamaica Electric Light Company for lighting the village at a cost of $10,500. Decision was reserved.

TONAWANDA, N. Y.—The City Council has granted to the Niagara Falls Power Company a franchise giving it permission to construct and operate transmission lines through this city over the already announced route between Buffalo and Niagara Falls. The company agrees to distribute in Tonawanda at least 500 horse-power at a rate not greater than that paid in Buffalo.

FOSTORIA, O.—The City Council passed an ordinance awarding a contract to the Fostoria Light & Power Company for 120 arc lights, for a period of 10 years, at the rate of $90 per annum per light. The ordinance specifies what kind of machinery is to be used and requires the company to put in an incandescent plant. The directors authorized an assessment of $10,000 for the necessary changes in the plant, and authorized the president and secretary, Hon. Charles Foster, of this city, and Hon. T. M. Beer, of Ashland, to enter into a contract with the city.

NEW ORLEANS, LA.—The City Council has investigated the candle-power of the arc lamps and the service rendered the city by the Louisiana Electric Company under the receivers. Tests made by Alfred Raymond, city electrician, show that the Louisiana Company's current falls three amperes short of the proper amount; that the service is uncertain and much below requirements. The City Council, in view of this report, has refused to pay the Louisiana Company the back pay due for arc lighting and has offered to compromise the matter on a basis of 22 per cent. on the amount of charges for electric lighting for the past months. The Louisiana Company is reconstructing its plant and making extensive improvements in order to bring the city lighting up to the proper standard.

The Electric Railway.

WESTMINSTER, MASS.—D. C. Miles is circulating a petition to raise $100,000 for an electric railway company.

PHILADELPHIA, PA.—The Union Traction Company will inaugurate a Willow Grove service on the Tenth and Eleventh Streets line.

NEWARK, N. J.—The West Orange Township Committee held a meeting and discussed a proposition to have a trolley line run over the mountain.

PHŒNIXVILLE, PA.—There is a probability that the now abandoned D. R. & G. R. R. will be converted into a trolley road and will be extended to Phœnixville.

WICKFORD, R. I.—Surveys have been commenced by W. C. Clark, of Wakefield, for the construction of the electric railway between Wickford and Narragansett Pier.

GLOUCESTER, MASS.—The stockholders of the Gloucester, Essex & Beverly Street Railway Company have decided to build the street railway from Ipswich to Rowley.

BALTIMORE, MD.—An effort will be made to have the City Passenger Railway extended to Parkville on the Harford Road, about two miles from the present terminus.

GENEVA, N. Y.—A trolley line from Auburn westward is projected, to cross Cayuga Lake and connect with the Geneva, Waterloo, Seneca Falls & Cayuga Lake Electric Railway.

WOODBRIDGE, N. J.—The trolley ordinance granting a franchise to the Union Traction Company has passed a second reading, and will be finally approved at the next meeting.

PITTSBURG, PA.—The Corporations Committee of Pittsburg Councils met and recommended an ordinance permitting the Park Avenue Street Railway Company to lay a single track in that street.

MORRILL, ME.—The Portland Railway Company is soon to begin the erection of a large brick and iron car house upon the site of the present one. The new building will be 76 by 273 feet in dimensions.

LUDINGTON, MICH.—It is stated that an electric road will be built from Ludington to Hart, a distance of 18 miles, to enable Oceana County fruit growers to ship their fruit to Milwaukee by the way of Ludington.

TORONTO, ONT., CAN.—There is talk of constructing a trolley road between Toronto and Hamilton. President McKenzie and Electrical Engineer McCullough, of the Toronto Railway Company, can give further information.

WASHINGTON, D. C.—A. E. Randle, of the Capital Railway Company, has made application for a permit to construct the road from Congress Heights to the Navy Yard. Work will be commenced as soon as the permit is granted.

PATCHOGUE, L. I.—The Patchogue & Port Jefferson Traction Company has applied to the Highway Commissioners of Brookhaven for permission to build a railway from Patchogue to Port Jefferson, which will run through Waverley, Seider and Terryville.

BEAVER FALLS, PA.—Several of the principal stockholders of the Beaver Valley Traction Company have purchased a controlling interest in the Grand View Electric Street Railway of this place, and the two lines will be operated under one management.

MACON, GA.—The Consolidated Street Railway Company will run a line across the new bridge when completed and traverse all that portion of East Macon lying between the bridge and Fort Hill, where it will be joined to the extension which is now being built.

NEW YORK, N. Y.—The White Plains & Elmsford Electric Railway Company, it is reported, will begin construction work on its line at once and trust to the public spirit of the authorities of Tarrytown to give it a fair franchise for running the line through that town.

HOLBROOK, MASS.—Plans have been completed for the organization of the Randolph, Holbrook & Nantasket Beach Electric Street Railway and for the immediate construction of the same. The road will be operated by the Braintree & Weymouth Street Railway system.

IRWIN, PA.—The officials of the Greensburg, Jeannette & Pittsburg Electric Railway Company have laid out a new route from here to Pittsburg. They have secured the right of way to the Valley Road to connect with the Versailles Avenue line in McKeesport, and by that line to Pittsburg.

Personal Notes.

MR. ELIAS E. RIES, of Baltimore, has moved to New York City, where he will open an office and engage in the manufacture of a number of his electrical specialties. Mr. Ries is well known as the inventor of many ingenious and meritorious electrical devices.

MR. CYRUS ROBINSON, 26 Cortlandt Street, New York City, was an admirer of the McEwen engine and the Thompson-Ryan dynamo even before he became the manager of the sales department of the J. H. McEwen Manufacturing Company. He says, however, that the more he knows of both the engine and the dynamo the better he likes them. Mr. Robinson is an engineer as well as a business man, and his experience with the General Electric and subsequently with the Jeffrey Manufacturing Company qualifies him admirably for his present position, in which he is doing splendid work and meeting with merited success.

JOHN H. DALE.—Recent events have brought to the attention of the electrical trade the business career of John H. Dale, senior member of the late Dale Manufacturing Company. In 1887, while a mere boy, Dale entered the office of the United States Illuminating Company, in New York City. Being a natural mechanic, he at once proceeded to acquire a thorough practical knowledge of electric lighting and the construction of electrical appliances. While serving his apprenticeship, young Dale invented a number of devices useful in operating the incandescent system of electric lighting. In 1888 he embarked in business on his own account, receiving therefor financial aid from a friend. He started his first shop at 90 Fulton Street under the name of the Dale Manufacturing Company. In less than a year Mr. Dale had bought out the interest of his partner and thenceforth successfully conducted the business alone until 1893, having in the mean time (in 1891) removed his shop to 22 Cortlandt Street, and greatly enlarged his plant and business. Mr. Dale again, in 1893, took a partner which, however, subsequently proved to be a most unfortunate connection. The new firm opened a supply department which proved unprofitable, and this with other new enterprises which at their inception looked promising resulted disastrously. These misfortunes no doubt tended to precipitate the troubles which came upon the firm during July of the present year. Mr. Dale during the eight years in which he has been in active business has invented a large number of valuable specialties in the electrical fixture line which are now in general use throughout the United States. He also personally designed and constructed the necessary machine for the production of these specialties. He has traveled throughout the United States extensively in the interest of his manufactures. The entire plant of the late Dale Manufacturing Company has been purchased by the Dale Company, of which concern Mr. Dale is president. He will superintend the manufacture and sale of the new concern's products, and his aim will be to produce specialties in the electrical fixture line of simple and substantial construction. Mr. Dale is enthusiastic in his work and has a thorough knowledge of the requirements of the trade and absolute confidence in his ability to meet these requirements. It will be seen therefore that with these essential qualities he will make a success of his latest enterprise.

Trade and Industrial Notes.

MESSRS. HUEBEL & MANGER, 277–281 Graham Street, Brooklyn, N. Y., makers of electrical and brass goods, have issued a new and very complete catalogue of bells, gongs, push buttons and the firm's patented novelties Making a specialty of this class of work, they produce well-designed, well-finished, artistic and saleable articles. Their products are handled by a number of the largest electrical supply houses, and are considered standard. Their catalogue should be in the hands of all those dealing in these goods. It will be sent free on application.

MESSRS. HAMMACHER, SCHLEMMER & CO., 209 Bowery, New York City, have just issued a new and elaborate catalogue, in which are listed and illustrated nearly all the hand tools used by the electrical trade. The book will prove of interest and value to both the buyer and user of electrical tools, and will undoubtedly secure to its publishers a large share of the Fall orders.

J. H. BUNNELL & CO.—We have just received from this well known New York supply house a copy of its catalogue, No. 15, just off the press; also a copy of a new edition of Wells' Electropathic Guide, a copy of which is furnished with the firm's No. 4 D.D. Medical Battery. The catalogue is much enlarged, and contains many new illustrations. On the front cover is a reduced repro-

duction of one of the diplomas awarded to the firm by the World's Columbian Commission. Copies of both books can be had on application.

ELECTRICAL POWER IN A STEAM PLANT.—Electricity performs a very large service in the new steel plant of the Apollo Iron & Steel Works at Vandergrift, Pa. The electrical power plant consists of three 400-hp side-crank medium speed engines of the latest type recently brought out by the Ball Engine Company, Erie, Pa., which are direct-connected to Westinghouse generators. These generators furnish power to 36 different power motors operating various machines including the electrical centrifugal pumps furnishing the water supply of the steel works, which comes from the river, 12,000 feet away.

THE "PIONEER" enclosed arc lamp, which has stood the test of time, may safely be said to be one of the most efficient lamps for indoor illumination now on the market. Customers who formerly complained about the poor light given by their arc lamps have found their demands fully satisfied by the "Pioneer." Since the discovery of the Marks method of operating enclosed arcs on incandescent circuits the open lamp has been gradually going into disuse. The customer who is looking for the most light at the least expense will do well to investigate the claims and guarantees of the Electric Arc Light Company, manufacturer of "Pioneer" lamps, 687-689 Broadway.

THE DALE COMPANY.—A corporation styled "The Dale Company," and formed under the laws of the State of New York, has succeeded to the business of the Dale Manufacturing Company. Mr. John H. Dale is the president of the new company and he will have personal charge of the manufacture and sale of its products, which will be continued on the same lines followed by the old concern. New facilities will be added, however, and the execution of work will be even more prompt than heretofore. All orders will be filled according to the old Dale Manufacturing Company's catalogue numbers. The company's agents are: Kennedy & Du Perow, Washington, D. C.; Pettingill-Andrews Company, Boston; the Standard Electrical Works, Cincinnati; Michigan Electric Company, Detroit; Robbins Electric Company, Pittsburg; Commercial Electric Company, St. Louis; the Western Electric Company, Chicago, and the Western Electric Company, New York.

THE WALKER COMPANY.—Among recent orders received by the Walker Company, Cleveland, O., may be mentioned incandescent lighting machines as follows: Two 100-kw and one 50-kw direct-connected multipolar generators for Murray Hill Hotel, New York City, and switchboard complete; two 75-kw direct-connected multipolar generators for Windsor Hotel, New York City; one 50-kw direct-connected multipolar generator and switchboard for Cochin China. Orders for railway generators are as follows: Six 600-kw special rope-driven multipolar generators and switchboard for Chicago City Railway Company; four 200-kw direct-connected multipolar generators for Englewood & Chicago Railroad (storage battery road); one 400-kw direct-connected multipolar generator for London Street Railway Company, London, Ont.; one 300-kw direct-connected multipolar generator for Pacific Power Company of San Francisco, Cal.; two 150-kw direct-connected multipolar generators and switchboard for Albion Construction Company, Chicago, Ill; one 1200-kw direct-connected multipolar generator for Metropolitan Street Railway Company of Kansas City, Mo.; two 400-kw direct-connected multipolar generators and switchboard for Brooklyn Bridge; one 800-kw direct-connected multipolar generator and switchboard for Albany Railway, Albany, N.Y.; two 800-kw direct-connected multipolar generators and switchboard for Syracuse Street Railway Company, Syracuse, N. Y.; two 100-kw belted generators for Bambern, Germany; two 250-kw direct-connected multipolar generators and switchboard for Newcastle Electric Company, Newcastle, Pa. Among recent orders for equipments may be mentioned: Twelve double No. 3 narrow gauge motor equipments for Hamburg, Germany; forty No. 5 double motor equipments for Brooklyn Heights Railway Company, Brooklyn, N. Y.; twenty-three No. 10 special storage battery equipments for Englewood & Chicago Electric Railway, of Chicago, Ill.; four double No 10 motor equipments to Union Railway Company, of New York City; five double No. 10 motor equipments for Albany Construction Company, of Chicago, Ill.; one double No. 3 motor equipments for Meridian Street Railway Company, of Meridian, Miss.; one double No. 3 motor equipment for Market Street Line, San Francisco, Cal.; eleven double No 15 motor equipments for Rapid Railway Company, Detroit, Mich.; eight 50-hp for Union Railway, New York City. Among recent shipments are: One 400-kw direct-connected multipolar generator to Rapid Railway Company, Detroit, Mich.; two 750-kw direct-connected multipolar generators to Detroit Railway, of Detroit, Mich.; one 800 kw direct-connected multipolar generator for Los Angeles Street Railway Company, of Los Angeles, Cal.; one 26-kw direct-connected, 220 volt, multipolar generator for Abner-Doble Company, of San Francisco, Cal; one 50-kw direct-connected incandescent lighting machine for Jordan, Marsh & Co., Boston, Mass.; three 25-kw direct-connected incandescent lighting machines for Mohawk Building, Cleveland, O.; five double No. 5 motor equipments to Hamburg, Germany; nine double No. 3 narrow gauge equipments to Paris, France; five double No. 4 motor equipments to Rahway, N. J. and numerous others.

Business Notices.

The illustrations in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 15 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED AUG. 25, 1896.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

566,288. RING ARMATURE; F. B. Badt and O. S. Lyford, Jr., Chicago, Ill. App. filed Jan. 15, 1896. In an armature for dynamo-electric machinery affording practically no passage for the exit of air-currents at its outer circumference, the combination with a laminated armature core constructed in sections, of continuous radial spaces provided between the said sections parallel to the plane of rotation of the armature, and lateral passages provided at intervals in the body of the armature core connecting the said radial spaces with the external air, thereby permitting a circulation of air through the said radial spaces and the lateral passages.

566,298. FAC-SIMILE TELEGRAPHY; H. W. C. Cox and R. J. Crowley, London, England. App. filed June 19, 1895. In fac-simile telegraphy the composition of an electrically-conducting ink capable of permeating an insulating substance, and rendering the paper electrically conducting through such ink trace, consisting of an excess of free acid with an electrically conducting salt, with a coloring matter such as anilin dye.

566,313. SELF-WINDING ELECTRIC CLOCK; E. G. Hammer, Brooklyn, N. Y. App. filed Jan. 12, 1891. In an electric clock wherein the escapement-spring is wound by an electromagnet, said spring and said magnet in combination with a lever tilted by said magnet, a rod connected thereto, a vibrating arm connected to said rod, an arbor connected to said spring for winding it, a ratchet on said arbor having peripheral teeth and having crown ratchet teeth, a pawl fulcrumed on said arbor, operated by said arm, and having crown ratchet teeth engaging the teeth of said ratchet, a locking pawl engaging the peripheral teeth of said ratchet and a spring pressing said ratchet into engagement.

566,334. APPARATUS FOR REGISTERING THE NUMBER OF TELEPHONIC CONVERSATIONS; A. Munch, Charlottenburg, Germany. App. filed Oct. 25, 1804. In an apparatus for registering the operations of telephones, a telephone circuit, its switchboard having a socket, a switchboard plug moving into said socket in a predetermined path and having a head at its inner end and a recess outwardly of said head, a registering mechanism, an electromagnet controlling operation thereof and an electric circuit for said magnet in combination with a switch for said last-mentioned circuit consisting of contact pieces, the one having a projection extending laterally of and into the path of movement of the head of said plug, located outwardly of the head of and opposite the recess of said plug when the latter is home in said socket, and moving laterally of the plug by the head thereof when the plug is moved toward or from its home position, and when so moved operating said switch, and moving into said recess when the plug is home, whereby the operation of said switch is only momentarily during the movement of said plug.

566,341. ELECTRIC HEATER; H. O. Rockwell, St. Louis, Mo. App. filed Feb. 8, 1896. In an electric heater, a suitable plate or body portion, forked ends forming a part of the same, cap pieces adapted to be received by said forked ends, and a suitable resistance coil carried by the plate, said coil being wrapped around the body of the plate, and the successive windings or wraps of the coil passing through the space included between the forked ends and the adjacent surfaces of the body of the plate and cap piece.

566,345. TROLLEY SUPPORT FOR ELECTRIC RAILWAYS; S. H. Short, Cleveland, O. App. filed April 20, 1896. In a trolley support, a spring rigidly secured at one end to the car body, an arm or rod mounted on said spring and adapted to engage the same at different points in the length thereof, and carrying a spring at the outer or free end thereof, and a contact device mounted on said last-mentioned spring.

566,366. BRUSH HOLDER FOR DYNAMO-ELECTRIC MACHINES; C. E. Woods, Chicago, Ill. App. filed Jan. 15, 1896. A brush holder for dynamo-electric machines comprising a frame having a series of brush-holding devices connected therewith, each brush-holding device provided with a movable part adapted to engage the brush, and a series of elastic connecting devices, connecting said movable parts together whereby the brushes when in position are elastically forced against the commutator.

566,376. TROLLEY WIRE HANGER; W. Cooper, Schenectady, N. Y. App. filed Sept. 23, 1895. In a trolley wire hanger, the combination of an insulating-bar, metal pieces secured to the bar to which the trolley pole is secured, and a support for the hanger permitting it to slide to and fro, but preventing it from slipping out of line.

566,397. ELECTRIC RAILWAY CONDUIT; W. S. Hull, Dallas, Tex. App. filed Feb. 28, 1806. The combination with a horizontally divided conduit, of a continuous metallic conductor, and a sectional metallic segmental conductor laid upon the upper interior walls thereof, and insulated from the same and from each other, and an inner, insulating tube held between the sections of the conduit, and a hollow metallic spherical switch adapted to travel bodily through the conduit in contact with said segmental conductor.

566,416. TELEPHONIC APPARATUS; C. J. Schwartze, Adrian, Mich. App. filed Feb. 11, 1896. In a telephone, the combination with a magneto-electric generator for signaling, of a microphone-transmitter, in magnetic inductive relation to said generator, and adapted to have its microphonic material agitated by the magnetic influence in the operation of the generator.

566,426. SYSTEM OF CONTROL FOR ELECTRIC MOTORS; E. A. Sperry, Cleveland, O. App. filed Feb. 16, 1895. In an electric controller, a moving element, a motor or motors connected thereto, a reversing switch, power and brake circuits for the motor or motors, the moving element organized to change the connections of the motor or motors from one to another of the circuits, mechanism for operating the reversing switch at the time of making the change in combination with means for changing the relative reversed condition of the motor or motors when connected to one or another of the circuits.

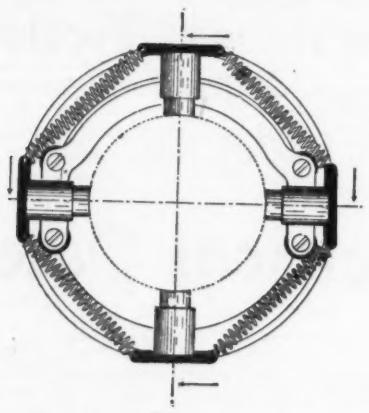
566,468. INSULATOR SUPPORT; J. B. Oliver, Shield's Station, Pa. App. filed Dec. 30, 1895. The combination with a metallic insulator support, having a collar against which the glass insulator abuts, of interfitting screw threads upon the support and insulator, and a packing of hemp or similar material in said screw threads.

566,499. SIGNAL APPARATUS; J. P. Coleman, Edgewood Park, Pa. App. filed May 21, 1896. The combination of a signal, a mechanical device for operating the signal, a fluid pressure cylinder, a piston forming the pneumatic slot between the signal and the mechanical device.

566,563. AUTOMATIC SIGNALING; J. P. Culgan, Swissvale, Pa. App. filed March 18, 1896. In a signaling system, the combination of two or more track circuits controlled by movement of trains, two or more electrically-controlled home signals controlling train movements along the track sections, two or more electrically-controlled distant signals indicating the position of succeeding home signal or signals, each distant signal being arranged to occupy the position of the home signal of the preceding section, a circuit for each of the home signals including a distant-signal operating mechanism, a second circuit for the distant signal, and circuit-breakers in said circuits controlled by the track circuits being so arranged that the movement of a distant signal is controlled by two adjacent track circuits.

566,507. CONDUIT OUTLET INSULATOR; F. W. Erickson, Revere, Mass. App. filed June 3, 1896. An outlet insulator for conduits consisting of a hollow metallic member adapted to be connected to the metallic pipe of the conduit, and an insulating member enveloping the outer and inner surfaces and the end or edge of the metallic member opposite to the end which is attached to the conduit pipe.

566,531. METHOD OF MAKING SECONDARY OR STORAGE BATTERY PLATES; W. Petschel, Germany. App. filed Jan. 13, 1896. A process of making porous material for the plates of storage or secondary batteries, such process consisting in mixing or stirring together oxide of lead with sulphate of zinc in solution, so as to form a paste, then moulding the paste, drying and then submitting to the action of dilute acid.



No. 565,366.—Brush Holder for Dynamo Electrical Machine.

566,537. ELECTRICAL HAMMERING MACHINE; T. C. Robinson, Boston, Mass. App. filed March 6, 1895. A tack-driving machine, comprising a casing or holder, a tack-delivering throat at one end of said casing, means supported by the casing for delivering tacks to the throat, a driver movable in said throat, an electric motor within the casing organized to project and retract the driver, a motor-controlling switch, and electrical connection between said switch and motor whereby the motor is caused to project and retract the driver.

566,541. ELECTRIC SWITCH AND SIGNAL APPARATUS; J. G. Schreuder, Wilkinsburg, Pa. App. filed March 31, 1893. In a railway signaling system, the combination of a centrally-located electric generator constructed to generate currents of sufficient potential to operate the most distant circuit of the system, a main conductor connected to one pole, two main conductors connected to the other pole of the generator, a switch arranged in one of the two conductors connected to the same pole of the generator, two or more track circuits connected to the uninterrupted main conductors, two or more signal circuits connected to the same conductors, two or more circuits for electric lights connected to one of the uninterrupted main conductors and to the main conductor provided with a switch and converters interposed in the track, signal and light circuits.

566,542. ELECTRIC RAILWAY; C. Skinner, Chicago, Ill. App. filed March 7, 1895. In an electric railway, the combination with a car, plows depending from each end thereof, the motor therefor and electric collector of a sealed box, current wire insulated therefrom and extending therethrough, a vertical plunger engaged by said plows, a vertical contact-post normally disconnected from said wire, and devices for mechanically connecting said plunger and contact-post, whereby said post is moved upward and establishes an electrical connection between said wire and collector when said plunger is raised, and which disconnects the same when said plunger is depressed.

566,545. ELECTRIC HEATING APPARATUS; R. A. L. Snyder, and A. F. Tinnerholm, Pittsburg, Pa. In an electric heating apparatus, an open magnetic core, a short-circuited secondary surrounding the said core, a primary coil wound on the outside of the said short-circuited secondary.

566,564. ELECTRIC HEATING APPARATUS; M. W. Dewey, Syracuse, N. Y. App. filed July 24, 1891. The combination of transparent or semi-transparent imitation fuel, an electric device for illuminating the same, and an electric conductor for generating heat.

566,573. ELECTRICAL INDICATING AND CUT-OUT APPARATUS FOR PORTABLE OR OTHER ELECTRIC LAMPS; R. Hacking and G. Brand, Nottingham, England. App. filed Jan. 13, 1896. The combination with a portable electric lamp and the circuit connections, of a base board therefor having an opening in it and a time-piece supported by such base-board, a stop-lever with one end adjacent to the balance of the time-piece, a switch and circuit-closing contacts and a connection between the switch and the stop-lever at the aperture in the base, whereby access is given for moving the switch to simultaneously turn off the current and stop the time mechanism or the reverse.

No. 566,537.—Electrical Hammering Machine.

566,612. ALARM FOR BOILERS; J. O'Connor and C. Turner, New York. App. filed March 20, 1896. In an alarm for boilers the combination of a chamber, a float arranged therein and adapted to rise and fall with the level of the water in the boiler, a rod connected to and actuated by the float and extending outside the chamber, a contact screw arranged to engage and stop the rod when the same is moved, a support in which the contact screw is adjustably mounted and an electric circuit, including a battery and a bell and having for its terminals the said contact screw and rod.

566,613. STEAM GAUGE; J. O'Connor and C. A. Turner, New York, N. Y. App. filed March 20, 1896. The combination of a steam gauge comprising a casing having a scale, a rotative shaft and an index on the shaft playing over the same, a sleeve surrounding but insulated from the shaft, a wheel mounted on the sleeve, a contact-arm on the wheel arranged in the path of the index, a shaft extending outside the casing and geared to the wheel for turning the same, and an electric circuit including the generator and an electrically-actuated device, said circuit having as its terminals the said index and contact-arm.

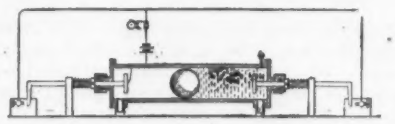
566,648. TELEPHONE EXCHANGE SYSTEM AND SWITCHING APPARATUS; A. R. Bennett, London; G. J. Somerville, Heaton Chapel, and R. McLean, Nottingham, England. App. filed March 20, 1896. In a metallic-circuit telephone exchange system, the combination with the subscriber's metallic loop, of a source of electricity, together with means under the control of the subscriber for connecting in a ground circuit the said source of electricity with both wires of the metallic loop at the central-station end of two operators' sets of speaking apparatus, any suitable switching, a pair of equally-wound resistance coils, and electromagnetic means for connecting the two wires of the metallic loop to the terminals of the operators' speaking sets, and at the subscriber's end a subscriber's telephone and signaling set of apparatus, a pair of equally wound resistance coils, and the aforesaid means for closing the ground circuit at will inserted in a leg connecting to ground a point of the metallic loop midway the two last-named resistance coils.

566,652. ARC LAMP HANGER; W. S. Bosley, Chicago, Ill. App. filed Feb. 13, 1896. The combination with a pair of springs connected, respectively, with two opposite sides of the light circuit, of a short-circuiting strip with which said springs are normally in contact, a second pair of springs disposed, respectively, opposite said first-mentioned springs and connected with the opposite sides of the lamp, a pivoted lever adapted when rotated to move the first-mentioned springs out of contact with said short-circuiting strip and into contact with said second-mentioned springs and a cross-piece carried upon the cables from which the lamp is suspended adapted to engage and rotate said lever.

566,693. ELECTRIC RHEOSTAT; H. W. Leonard, New York, N. Y. App. filed May 10, 1895. The method of preventing undue heating in an electric conductor, which consists in absorbing a large portion of the heat energy developed in the conductor due to the passage of a current, by placing the conductor in close proximity to a large mass of material having a high specific capacity for heat.

566,697. ELECTRIC CABLE CONDUCTOR AND SHEAVE WHEEL; J. F. Place, Montclair, N. J. App. filed April 12, 1894. In an electric cable conductor, the combination of copper with other metal and insulating material, so arranged that the copper forms the outside and the other metal the core or inside of said conductor, with the insulating material as an annular ring between said copper and other metal.

566,709. BOND CONNECTOR FOR RAILS; J. Bryan, Pittsburg, Mass. App. filed May 21, 1896. In a bond connector for rails, the combination of a plate or holder provided with a seat for a bond wire, soft or easily malleable metal interposed between the plate and rail, and a bolt for attaching the plate to the rail.



No. 566,612.—Alarm for Boilers.

566,714. SWITCH FOR CONDUIT SYSTEMS OF ELECTRIC RAILWAYS; J. L. Hornig, St. Louis, Mo. App. filed Aug. 26, 1895. In an electric conduit switch, a suitably closed casing or receptacle, a block of insulating material removably located within the receptacle, discs arranged for rotation within said block, shafts passing through said discs to the exterior of the casing, links fixed to the outer ends of said shafts, a plate pivoted to the upper ends of said links, conducting plates passing through the discs, brushes, the ends of which ride on the peripheries of the discs, and are arranged to contact with the conductor-plates, and suitable electrical connections to said brushes.